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ABSTRACT

This study presents a design for a biennial survey which would provide a nation-wide, in-depth sampling of supply and demand for educational research, development, diffusion, and evaluation personnel. An extensive preliminary study and analysis led to recommendations for a more modest initial survey focusing on the demand for three priority populations: a) the core of federally funded RDD&E performers, b) the RDD&E activities in local education agencies, and c) federal monitors and other federal professionals and paraprofessionals engaged in educational RDD&E. The survey is designed to generate projections on the basis of program funding information and will use a mail survey augmented by interviews. The questions included in the draft questionnaire and the recommended analysis are fully detailed. Discussion of sample selection, instrumentation and the creation and use of an educational RDD&E data bank are included. Appendixes provide a literature survey, background information on manpower resources and requirements, the capabilities of existing data processing systems, and survey cost support information. (Related document is SP 005 628.) (MBM)

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FINAL REPORT
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DESIGN OF A SURVEY FOR DETERMINING TRAINING AND PERSONNEL REQUIREMENTS FOR EDUCATIONAL RESEARCH, DEVELOPMENT, DISSEMINATION AND EVALUATION

VOLUME ONE
(one of two volumes)

MAIN REPORT

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Maury Chorness

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Chapter 1

SUMMARY

"Educational research in the United States is going through a period of agitation, ferment, and perhaps even crisis." Although Hendrik Gideonse wrote these words in 1969, they could not be more relevant in 1972. The massive, almost ten-fold increase in appropriations by USOE for "research and training" between the early and late 1960's was a major funding discontinuity which saw the establishment of many new education R&D institutions and unprecedented federal commitment to "disciplined inquiry" that brought the terms educational development, diffusion, and evaluation into general usage. By the late 1960's there were heady projections suggesting a most likely five-fold (and as much as a seven-fold) increase in the numbers of educational research, development and diffusion personnel (Clark and Hopkins, 1969). Nearly 100 research training programs were funded by USOE to provide an adequate supply of trained manpower, but few of these training programs were initially prepared to cope with the new areas of D,D&E. The directors of the new federally funded projects and programs soon expressed concern over the lack of appropriately trained talent. Interest and concern were so great that Gideonse (1969, p.v.) noted that in 1968 and 1969 alone "no less than 10 studies have been or are being conducted on educational research and development." By 1972 there are several times as many studies.

Yet all has not been well. The three-year period of virtually level funding for educational R&D "whether measured by United States Office of Education, National Science Foundation, or other Federal agencies' appropriations" as Gideonse noted in 1969, has now extended into its sixth year and is set in a context of decelerating expenditure and significant readjustments throughout the entire American R&D Community (Michael March, 1970; NSF, 1970). The graduate schools throughout the country, now geared to produce needed scientific personnel, are producing an ample supply for a retrenching scientific labor market. Current unemployment and projected oversupply of scientists and engineers is now a major problem for the physical sciences and a matter of concern for the behavioral sciences (see Chapter 3, pp. 3.27-3.29).

At the same time that the educational R&D Community has been confronted with several years of limited or no real growth in federal funds, it has been reproached for its lack of productivity and discernible impact on educational practice in both the Congress and the Executive Branch. Legislators and administrative spokesmen have made it clear that extensive increases in funding may come only when a markedly better case for educational R&D investment can be made and practical evidence of impact on improvement of educational practices is submitted.

Some educational researchers have placed their hopes in a National Institute for Education (projecting a vision of accomplishment similar to that of the National Institutes of Health), that could "put it all together" in making a case for increased educational R&D funding. The size and character of the National Institute for Education and the direction it may give to educational R&D, is still conjectural, but it is apparent that the United States Office of Education has increasingly committed its scarce discretionary R&D dollars to problem solving, mission oriented efforts such as Right-to-read, Career Education, Experimental Schools and a proposed "Renewal Thrust" as well as a broad array of development and dissemination efforts to aid the handicapped).

All of these efforts are relatively massive and complex, indeed almost overly ambitious in their goals and objectives, given the short time lines, limited funds, fragile knowledge and technology base, and possible lack of sufficiently trained and experienced personnel.

This then is the context for educational RDD&E in the early 1970's. Yet surprisingly little is known with assurance regarding either supply or demand for trained personnel, despite the many volumes of reports and studies. This situation exists because there has never been a nation-wide, in-depth, probability sampling survey of supply and demand for educational research, development, diffusion and evaluation personnel. The desire to rectify this condition led to the conception of the biennial survey, which is fully outlined in Chapter 2.

An extensive preliminary study and analysis (described in Chapter 3) coupled with the knowledge that funds for the 1972 survey would be limited, led to recommendations for a more modest initial survey focusing on an in-depth study of the demand side of the problem for only three priority populations: (a) the "core" of federally funded educational RDD&E performers, (b) the RDD&E activities in local educational agencies (LEA's), and (c) federal monitors and other federal professionals and paraprofessionals engaged in or administering educational RDD&E. A remarkably comprehensive survey of RDD&E in state educational agencies, to be published in 1972, should round out information on these RDD&E populations which appear to be critical for the articulated execution of USOE priority programs.

The recommended survey has been deliberatedly designed so that personnel and training requirement projections can be made on the basis of program funding information, with reasonable accuracy into the short and mid-range future. The survey will also lay the groundwork for a more comprehensive survey of both supply and demand at a later time.

The survey recommendations (see Chapters 4, 5 and 6) provide options, but the recommended method is basically a mail survey of federally funded contractors/grantees and LEA employers and employees, augmented by field interviews and/or telephone interviews to provide greater in-depth exploration of complex or sensitive topics.

The sampling frames for federally funded performers are the federal agency lists of current contracts and grants, stratified by level of funding converted to a twelve-month equivalent basis. The funding information provides a measure of size for estimating number of personnel and for selecting projects as the primary sampling units.

Employees are subsampled from lists of personnel supplied by the sampled employers (or supplied from project budgets and corrected by employers). The sampling of employees is self-weighting, with the sampling fraction for primary units proportional to funding size and the sampling fraction for personnel inversely proportional. The sampling scheme for the

Local Educational Agencies is roughly similar except that size of student enrollment is used, as the measure of size to estimate numbers of RDD&E personnel, and as a basis for stratification. Because of the very low incidence of RDD&E activity in school districts below 12,000-student enrollment, it is recommended that the population either be truncated at this point or that a screening instrument be used to identify districts below this size with significant RDD&E activity.

The questions included in the draft questionnaire for employers and employees, and the recommended analysis, are fully detailed in Chapter 7. Questions addressed to employers relate to project (or LEA Unit) identification, project content and objectives or unit functions, level and sources of funding, major areas of work effort, personnel composition, recruitment, selection, attrition, anticipated hires, and training methods. Questions addressed to employees include information regarding age, sex, race, length of time on job, salary, supervisory responsibilities, job satisfaction and advancement possibilities, level of education, courses taken and major field for highest degree, types and amount of previous work experience and its perceived relevance to the current job, current involvement and interest in further training for 25 RDD&E activities, and value placed on various approaches to training and credit for training. Data for employees can be linked to data for employers so that relationships among more than 250 variables may be examined

Chapter 4 presents information on the design of the study, including discussion of the overall design, sample selection and instruments. Data collection is treated in Chapter 5 and creation and use of an Educational RDD&E Data Bank is described in Chapter 6.

Chapter 7 contains an outline of the recommended survey report, with extensive discussion of the mail survey data and its analysis, and illustrations of potentially important or informative analyses which may help to define the characteristics, personnel structure, activity, needs and requirements of educational RDD&E employers and employees in these performer populations.

Chapter 2

PURPOSE AND STATEMENT OF PROBLEM

Purpose and Objectives

The purpose of this study was to provide the Research Training Branch (RTB), Division of Research and Development Resources (DRDR), of the US Office of Education, with the design for a biennial Educational RDD&E Personnel Supply and Demand Survey. The survey is needed:

1. To assess the numbers and types of people currently employed in Educational RDD&E[1] and to estimate the future demand for employees in educational RDD&E activities (Demand Survey).

2. To assess the numbers and types of people with needed skills presently available for educational RDD&E employment and to estimate the future supply of available individuals for educational RDD&E employment (Supply Survey).

3. To integrate the information from the supply and demand surveys to determine present and future Educational RDD&E training and recruitment needs.

Statement of the Problem

Although several studies relating to educational research, development, diffusion, and evaluation (RDD&E) personnel training issues have been undertaken in the past few years (AERA series, 1971; Oregon Studies, 1970-71; Hopkins and Clark, 1969; Hood and Banathy, 1970; Fleury, Cappelluzzo & Wolf, 1970; Stufflebeam, 1970) each has been significantly flawed in one or more respects and, taken together, they provide at best a patchwork basis for establishing and justifying Office of Education programs involving the use or training of education personnel. Accurate information does not exist concerning such items as the numbers employed, types of employment, educational backgrounds, relevant experience, skill shortages, perceived adequacy of training programs, etc. The information that is available is either out-of-date, biased, confined to specific topics, regional, unvalidated, based on too small or inadequate samples, or otherwise of limited value. A "base-line" study is needed -- national in scope, technically adequate in design, and addressing itself to priority information requirements.

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[1] R&D is conventionally used as an abbreviation for research and development. This report will employ the convention "RDD&E" to refer to the entire set, or some unspecified subset, of research, development, diffusion, and evaluation. In most contexts the reference will be to educational RDD&E. Various authors have used other abbreviations: RDD, RDDDE, RDDE, R-D-D-E, etc. These forms will be employed only when needed to appropriately reflect an author's designation. RDD or E will be employed where emphasis on the four separate activities is required.

Survey Design Considerations

The objectives of the design phase of this study were to select and develop instruments, data gathering and processing procedures, analytic techniques, and planning information for the later implementation of the proposed survey.

Research Training Branch Questions

The following are examples of types of questions for which RTB personnel seek answers:

Demand Survey.

1. How many people are presently employed in educational RDD&E activities in the United States?
    a. In what types of activities (RDD or E) are they employed?
    b. At what professional levels (paraprofessional or professional) are they employed?
    c. What annual salaries do they receive?
    d. How many are employed full time; part time?
    e. What are the proportions for: age, sex, race, geographic distribution?
    f. In what types of institutions are they employed?
    g. How have they prepared for the jobs?
    h. How long have they worked in the same job activity (RDD or E), level, and institution?
    i. To what extent do they value their work compared to other jobs for which they are qualified?
    j. What future do they see for advancement?
2. How many additional people will be employed in educational RDD&E in 1975?
    a. How much of this additional employment will result from normal turnover (without growth) due to personnel leaving educational RDD&E or to promotions?
    b. Given a non-growth situation, how might changes among needs for RDD&E activities be reflected in differing demands for job skills?
    c. How will employment be affected by fluctuation in investments in educational RDD or E:
        (1) assuming stability in relationship of RDD&E activities?
        (2) if the relationship of RDD or E activities changes?
    d. Describe the fluctuations in demand in terms of differing demand for job skills as a function of fluctuations in educational priorities or program funding levels.

Supply Survey.

1. How many people are presently available for Educational RDD&E employment in the United States?

    a. For what types of RDD or E activities have they received formal or informal training?
    b. For which professional (paraprofessional) levels have they been trained?
    c. What educational background, experience or competencies do they possess?
    d. Would they be available for full- or part-time work?
    e. What is the distribution for age, sex, race and geographic region?
    f. In what types of institutions have the graduates received training (preservice, inservice)?
    g. Who has paid for training (individuals themselves, institutions directly, federal or state government through institutions)?
    h. In what types of institutions are they seeking employment?
    i. How many qualified people trained or experienced in areas related to educational RDD&E would be available for employment without additional specialized training?
    j. How many people trained or experienced in areas related to educational RDD&E would be available with minimal (less than six months full time) additional specialized training?
    k. How many people already employed in educational RDD&E could be employed at advanced levels (or in related RDD&E jobs in more critical areas) if they received additional specialized training?

2. How many additional people will be trained in educational RDD&E by 1975?

    a. How much of this additional supply of trained RDD&E personnel will result from existing programs, funded at present levels and focusing on developing the same skills as in the past?
    b. How much of this additional supply of trained personnel will result from existing programs, funded at present levels but focusing on different RDD or E skills than in the past?
    c. How much of this additional supply will result from new or expanded programs developing what kinds of skills?

Analysis of Supply and Demand.

1. What are the present educational RDD&E personnel recruitment and training needs based on the results of the demand and supply surveys?

    a. What types of training and recruitment activities are needed?
    b. For which professional (paraprofessional) levels should training and recruitment activities be developed?

c. What should be the focus of training and recruitment with respect to demographic characteristics (age, sex, race, geographic region)?
d. Should training and recruitment procedures be directed toward the needs of specific types of institutions?
e. What types of training programs (inservice or preservice) are recommended for different RDD&E activities and professional levels?
f. What funding sources and amounts are needed to support RDD&E training?
g. How can qualified people who have training or experience in educational RDD&E be recruited for relevant positions?
h. How can people with training and experience in areas related to educational RDD&E be given minimal (less than six months) additional specialized training?
i. How can people already employed in educational RDD&E be trained to perform at higher levels or in priority areas?

2. What are the projected RDD&E personnel recruitment and training needs for 1975 based on projections from 1972 demand and supply information?

   a. What training and recruitment policies should be followed if existing supply and demand rates are static until 1975?
   b. What training and recruitment policies should be followed if the total supply and demand employment rates are static, but mismatched in distribution among RDD or E skills?
   c. What training and recruitment policies will be needed if supply and demand levels increase at different rates?
   d. What training and recruitment policies will be needed if supply and demand levels increase at different rates and focus on different RDD&E skills?

The above set of questions is neither complete nor precisely stated, but it indicates many of the specific questions of interest to USOE Research Training Branch personnel.

Design Requirements

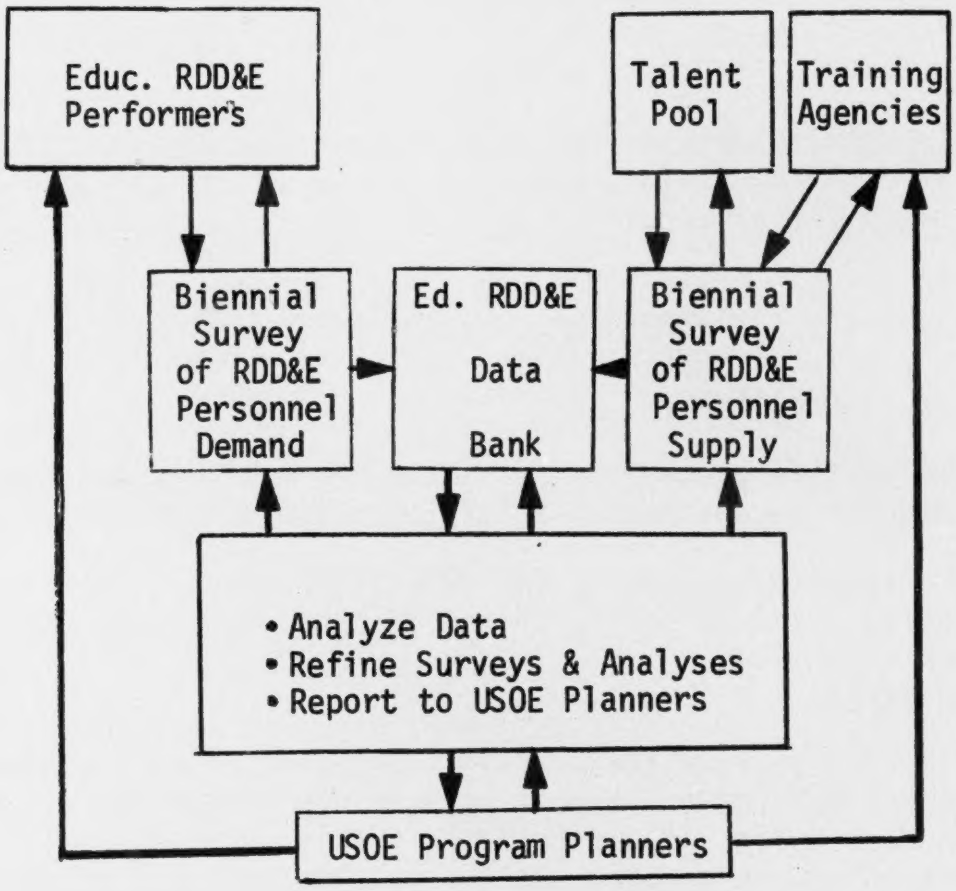
The survey design problem, as initially outlined, is illustrated in Figure 1.

The tasks for the design phase were:

1. To define and refine the problem as presented by the Research Training Branch.

Figure 1

Originally Proposed Biennial Survey of
Educational RDD&E Personnel & Training


Educ. RDD&E Performers
Talent Pool
Training Agencies
Biennial Survey of RDD&E Personnel Demand
Ed. RDD&E Data Bank
Biennial Survey of RDD&E Personnel Supply
• Analyze Data
• Refine Surveys & Analyses
• Report to USOE Planners
USOE Program Planners

2. To study the feasibility of and need for the proposed survey.

3. To study and make recommendations regarding (a) instruments; (b) data gathering and processing procedures; (c) methods of data processing, storage, retrieval and possible updating of a data bank; (d) data analysis; and (e) planning of the survey.

4. To select or develop and pretest instruments to collect information on educational RDD&E supply and demand related to the questions described above.

5. To specify methods for defining, selecting and sampling target populations, and for reaching the target samples and accomplishing follow-ups; and to make time, facility, personnel, and cost estimates for these methods.

6. To specify methods for data processing, creation of a data bank, storage, retrieval, and possible updating; and to make cost estimates for alternatives.

7. To develop a matrix of all supply and demand variables to aid analysis and retrieval; design a flexible system of analysis, and specify procedures for analysis; and to make cost estimates of alternatives.

8. To specify procedures for improving instruments, data collection, processing and analysis for the biennial survey.

9. To specify procedures for identifying trends in the biennial survey, and to verify or revise three-year projections.

Initial Analysis

Chapter 3 describes the preliminary analysis and planning work which was undertaken related to steps 1 (define and refine the problem) and 2 (study the feasibility of and need for the proposed survey). The conceptualization of the problem and the development of a proposed solution proved to be much more difficult than this report may suggest. Some of the problem areas are discussed below.

Definitions of populations. Educational research, development, diffusion and evaluation as separate functional activities have been recognized for hardly more than a decade and are not well defined.[2] There are questions regarding what basic research, if any, should be called educational research. What is the extent of applied educational research?

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[2] The Oregon Studies (Teaching Research Division, 1971) presents an unusually exhausting discussion of current conceptions of educational RDD&E.

For instance, does it include training research, instructional media research, etc.? Does collection and analysis of educational statistics qualify; or analysis of demographic, public opinion and cost information needed for planning and management of local or state education operations? How about an Army-sponsored research study of peer tutoring training methods? What is educational development? Would a commercial "educational" toy that has been modified based on consumer market tests of prototypes be considered a development? How about the third revision of Professor Smith's course in new math, or a computerized system for retrieval and display of student guidance information? Where does the field of educational diffusion begin and end? Are textbook salesmen part of the diffusion/dissemination labor pool? How about the instructional materials center librarian? Who in education isn't involved in "evaluation"? Doesn't every teacher and instructional supervisor engage in educational research, development, dissemination and evaluation? And how do we decide what is educational and what is not educational RDD&E? Is it educational RDD&E when business, industrial, military, or other organizations employ the same general procedures as those employed by educators for producing, evaluating or communicating reliable knowledge or practice aimed at training or providing people with more adequate methods of coping with the demands of their jobs or lives?

This is a sampling of questions to illustrate the problem of defining appropriate populations of:

Educational RDD&E performers (demand)
Personnel with appropriate competence (current supply)
Personnel with related competence (short-term trainable supply)
Training agency programs and capacity (future supply).

Some of the literature reviewed in Chapter 3 deals specifically with the definitional problem.

Survey Methods. The selection of a survey method or mix of methods is generally contingent on many factors such as the size and distribution of the population, the size and type of sample, the scope and complexity of the information required, the character of the informant population, the desired reliability and validity of the information, the desired degree of accuracy and precision of population estimates from sample data, availability of previous information or experience in conduct of and results from previous surveys of the same or related populations regarding similar subject matter, and of course the available time, financial and technical resources.

Initially, information concerning most of these factors could be described as "fuzzy." There were a number of previous surveys of educational research. Indeed Barger, Guba, and Okorodudu (1965) had created a National Register of Educational Researchers. There were several studies of USOE sponsored research training programs (e.g. Fattu, 1960, 1967; Lazarsfeld and Sieber, 1964; Krathwohl, 1965; Sieber and Lazarsfeld, 1966; Millikan, 1967; Sieber, 1968; Fleury, 1968). But there were few, if any published surveys of educational development, dissemination or evaluation that could be considered both comprehensive and technically adequate.

The kinds of technical information that permit optimal design were generally not available. The estimates regarding sizes of populations and subpopulations were gross; "related" RDD&E populations were best described as "abstractions"; variance data on types of items relating to questions such as those previously listed were generally non-existent. Discussions regarding the level of accuracy or precision actually required for specific items of information led to the conclusion that the major design constraint would be available funds. It was more a question of what could be learned about many different types of information with a quite limited budget than of what it would cost to obtain a well specified but limited set of survey requirements.

We assumed that some type of mail survey would be employed, and proceeded to initiate work on selecting items, development and pretesting of questionnaires suitable for mail survey of RDD&E employers and employees. But we also initiated investigations of the feasibility and costs of field interview and telephone surveys. A major continuing problem was to "scope-down" the objectives of the survey and find appropriate "trade-offs" among the design requirements and possible solutions, in the light of emerging design information and of discussions with USOE personnel regarding priorities and probable available funding for the survey.

Available sampling frames. Assuming that one has achieved well defined (and probably quite arbitrary) definitions of the educational RDD&E supply and demand populations suggested in Figure 1, there may be major problems in acquiring defensible lists of the members of these populations or alternately in prescribing feasible methods for producing the required lists. For instance, what registers, directories, membership lists would one use, if any, to locate persons "trained or experienced in areas related to educational RDD&E" who might, with less than six months' full-time training, fill (specified) RDD&E requirements for trained personnel? Or, how does one develop lists of non-profit agencies performing educational research or educational evaluation work? Or, given lists of U.S. colleges and universities, how does one proceed to construct and validate a list (or proceed in some other way to identify) departments, outside the college of education, which may contain programs or courses related to educational RDD&E training requirements?

The problems of developing sampling frames are different for RDD&E-performing agencies, personnel, and training agencies. If the performer group is restricted to federally funded activities the problem may be difficult but is at least tractable (see Gideonse, 1969; Clark and Hopkins, 1969). If educational agencies (regardless of funding source) are included, fortunately there are numerous directories and in some cases useful statistics (e.g., USOE National Center for Educational Statistics, NEA Research Division, NSF Office of Economic Manpower and Manpower Studies. Locating foundation-supported performers is a more tedious proposition, although the Science Information Exchange is a good place to start, followed by query of foundations supporting educational activity. Locating relevant educational RDD&E in business and industry, if it is not federally supported, appears to be most difficult. The National Science Foundation does prepare reports on R&D in industry, based on U.S. Census data; but neither the fields of basic research, nor the applied R&D product groups, nor the industrial classification, is relevant. Apparently the most productive approach may be to attempt to identify industrial performers through their associations (e.g. Association of American Publishers, Information Industry Association, National Audio-Visual Association, Association for Educational Communications and Technology, Educational Media Council, American Society for Training and Development).

One could attempt to locate performing agencies through association membership of their employees. In fact, in the case of the American Psychological Association Directory this is easily done since there is a Geographical and Institutional Directory.

There are two main approaches to identifying educational RDD&E personnel: (a) locating them through their employers, or (b) locating them through their associations. Sampling survey methods for selecting educational personnel through their employers have been used in studies of related RDD&E subject matter (Hood and Hayes, 1967; Chorness, Rittenhouse and Heald, 1968). When adequate employer samples can be generated and employer cooperation can be enlisted, this approach can be quite efficient.

Unfortunately the AERA Register (1965) is out of date. We explored a number of possibilities including use of the NSF National Register of Scientific and Technical Personnel, and use of directories of professional associations. The results are described in the next chapter. Briefly stated, we concluded that an approach through associations would probably be attractive only if a "census" of educational RDD&E personnel were needed in order to create a new directory or a talent search data bank. It is unlikely, given the present situation, that this approach would yield any better population estimates (than sampling employers and subsampling their employees); and the approach would undoubtedly be more costly or technically difficult.

There are other approaches than the two described above. One could, for instance, build lists of personnel based on their publications by using ERIC computer tapes, Research in Education, Education Index, Psychological Abstracts, etc. The problem with this approach is that it would be highly biased, i.e., grossly over-representing senior researchers located in academic institutions and under-representing professionals (and certainly paraprofessionals) engaged in DD or E in any setting.

When we turn to the question of locating personnel in related RDD&E areas, there are major definitional and technical problems. Reports on personnel and training produced by the National Science Foundation, the Office of Scientific Personnel of the National Research Council, and by the National Institutes of Health provide pertinent background information. Chapter 3 summarizes the more pertinent findings regarding numbers of personnel from various scientific disciplines contributing to federally funded educational RDD&E programs, field switching rates, etc. Unfortunately detailed information regarding specific skills possessed or training needed is not adequate even for those already employed in educational RDD&E. Until more detailed information regarding currently performing personnel is developed, the problem of defining useful questions for "related" personnel to answer seems to be an even larger problem than constructing sampling frames.

The several studies of education research training programs cited above provide guidance for the sampling of these programs. The most recent study (Byers, 1971) is in fact sufficiently recent and comprehensive so that we question the need to repeat such an effort in 1972. What is most missing from all the training program studies is information on programs and courses that may be available in "related" areas. This is similar in nature to the problem discussed above regarding "related" personnel.

Sampling methods. One of the few early design constraints we set constraint was that the survey results should yield reasonably accurate, if not highly precise, estimates of important characteristics for the defined populations. We knew that several surveys and studies of segments of the educational RDD&E population had been recently completed or were in progress; but, with possibly one or two exceptions,[3] none were of sufficient scope or of technically adequate design to afford much in the way of useful estimation of required population characteristics.

Hence, some type of random sampling seemed essential. The practical task, once populations and frames had been defined, would be to examine alternatives for producing a reasonably simple, practical and efficient sampling design that would also have desirable statistical and data analysis characteristics. This did not appear a difficult problem and we had expert consultant assistance available.

Data collection and processing. Compared to other areas, problems in this area seemed to be relatively simple, and amenable to standard procedures. Possibly the greatest problems would be in securing access to and cooperation of knowledgable personnel in performing and training agencies. Another problem appeared to be in defining questions with sufficient precision so as to elicit appropriate and interpretable responses.[4]

Data processing, storage and retrieval. Our consultants were able to identify a number of available file creation, management and analysis programs which seemed suitable for the general requirements that had been outlined. This did not appear to be a major problem area.

Data analysis and interpretation. For the most part, the data to be analyzed seemed to lend itself to relatively standard methods of analysis and display. One problem for analysis would be specification of priorities for areas of interest, since the number of combinations and partitions of data that could be accomplished would be enormous. A more serious problem appeared to lie in the selection of suitable methods for projecting supply and demand. And, as we struggled with questions of definitions of populations, problems of reaching appropriate respondents and securing their cooperation, and of framing questions, we became more concerned with the need to sub-sample to secure in-depth interview data, and to follow up on samples of non-respondents in order to guard against misinterpretation of the analyses.

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[3] Brickell (1970) conducted a survey of RDD&E in all 50 of the state education agencies. Byers (1971) made an extensive survey of Educational RDD&E training programs in graduate schools of education. In both cases the surveys approximate a census of the defined populations.

[4] Early experience with pretests of mail survey questionnaires made us increasingly aware of problems relating to enlisting cooperation, obtaining "sensitive" information, securing adequate response rates, and suitably framing questions and response alternatives.

Given the above list of initially perceived problem areas, we searched the literature, met with consultants, made visits to a number of federal agencies and professional associations, studied published and unpublished data and reports and conferred with USOE personnel. These activities and findings are reported in Chapter 3. The conclusions described in Chapter 3 indicated that there was insufficient information and certainly nowhere near the financial resources to make a technically adequate, cost-effective, comprehensive approach to the proposed survey as initially outlined.

Consequently, a markedly more modest initial effort, surveying only two priority subpopulations of education RDD&E performers (federal grantee/contractors and local educational agencies) and their employees was recommended. The recommended design, which is fully described in Chapters 4 through 7, focuses most heavily on the personnel and training demand side of the problem and will provide accurate estimation of currently perceived requirements and a reasonable basis for projecting personnel and training demands in these two priority areas. The survey has been designed so that subsequent surveys, designed on the basis of findings and experience with this initial survey, should provide more effective and less expensive survey information dealing with the range of educational RDD&E personnel and training issues confronted by the RTB questions listed above.

Chapter 3

PRELIMINARY ANALYSIS AND PLANNING

Chronology of Activities

Prior to the development of a design for the proposed biennial survey of supply and demand in the educational RDD&E personnel field, preliminary analysis and planning was undertaken to define the kinds of information required and to evaluate the need for and feasibility of the survey in the light of past, on-going and proposed studies. Chronologically, this preliminary effort began early in June 1971 with literature searches, a rereading of studies conducted by several RDD&E training design contractors (RFP #70-12), and conferences with the proposed subcontractors; William Madow and Carl Rittenhouse of Stanford Research Institute. On June 22, John Egermeier and Susan Klein, Research training Branch (RTB) U.S. Office of Education, met with Fred Martin (USOE advisory committee) and Paul Hood, the principal investigator, at the Far West Laboratory to discuss USOE policy information requirements. On June 23, Egermeier, Klein and Hood met with Consultants John Hopkins of Indiana University and Roger Sell of Teaching Research, to discuss the overall design requirements and problems.

Subsequent trips to Washington, D.C. were made on July 6-8, August 16-18, and September 5-8. Besides the U.S. Office of Education, other organizations and agencies visited included: American Educational Research Association, National Education Association, American Psychological Association, National Academy of Sciences, National Science Foundation, and Office of Manpower Research, Department of Labor. Paul Hood also attended a symposium in Washington, D.C. on behavioral science manpower requirements, which included participants from the National Institute of Health, the American Council on Education, the Scientific Manpower Commission, and the National Science Foundation; met with Dean L. C. Larson of Indiana University, who is conducting manpower studies in the educational audio-visual technology field; and made trips to confer with, and examine upublished data produced by, the Teaching Research[1] and AERA Task Force[2] contractors. Results of analysis of the information collected are presented in the subsequent sections of this chapter.

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[1] Teaching Research, Monmouth, Oregon, "The Generation of Information to Support Long-Term Manpower Studies of and Planning for Training Programs in Educational Research, Development, Diffusion and Evaluation."

[2] American Educational Research Association, Washington, D.C., "Task Force on Training Research and Research-Related Personnel."

Studies of Educational R&D Personnel and Training Requirements[3]

There are two reports which provide an invaluable introduction to the study of educational RDD&E personnel and training requirements: Educational Research and Development in the United States (Gideonse, 1969) and A Report on Educational Research, Development and Diffusion Manpower, 1964-1974 (Clark and Hopkins, 1969).

Gideonse's 1969 Study

Gideonse's Educational research and Development in the United States is the definitive study of the subject. Especially relevant to the design of a survey of R&D personnel and training requirements are: Chapter I on definitions and models of research, development and dissemination; Chapter II on organization, trends and issues regarding education in the U.S.; Chapter IV on sponsors of R&D; Chapter V on performers; Chapter VI on management; (especially) Chapter VII on financial and manpower resources; and Chapter VIII on the substance of American educational R&D.

The following quotation from the management Chapter (p. 98) provides an introductory perspective:

> "One of the particularly critical problems for the educational R&D manager is identifying, recruiting, and, if necessary, training the supplies of manpower required to perform the activities for which he is responsible. Manpower must also be sought to provide the technical and scientific expertise necessary for deciding on the merits of particular activities that may be proposed.
>
> "A considerable number of disciplines have relevance to instruction and education. The lack of careful definition

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[3] For those unaquainted with the literature on educational R&D personnel and training, we recommend that they read both Appendices A and B. In Appendix A will be found brief treatments and references organized in six areas: (a) impressionistic descriptions of current status and prescriptions for improvement; (b) studies of recruitment and training in other disciplines and professions; (c) studies focussing systematically on the doctorate in education; (d) studies bearing directly on the training of educational research personnel; (e) studies of RDD&E manpower requirements (including a brief description of Clark and Hopkins); (f) recent studies of employers' needs and training programs.

In Appendix B, we have reproduced the entire Manpower Resources section of Gideonse (1969), Chapter VII, which in turn draws heavily on Chapter 2 of Clark and Hopkins (1969).

The Far West Laboratory's analysis of national and regional (San Francisco Bay Area) RDD&E comprises Appendix C.

Relevant surveys and studies of other RDD&E training designers are summarized in Appendix D.

> of the various functions that comprise R&D and the skills requisite for the pursuit of each constitutes an additional complicating factor. After the roles are specified, availability of such people needs to be ascertained. If sufficient supplies are not available, training programs must be mounted.
>
> "Manpower requirements can be perceived in two ways. First, educational research and development programs require trained scientific and technical manpower to perform the many types of activities required to carry out a sustained, productive R&D effort. The range of competencies required may be considerable, not only for scientists from a broad range of disciplines, but also for support personnel in the form of technicans, dissemination specialists, and the full range of skills required for educational development.
>
> "Second, Manpower is required for management purposes. The particular responsibilities of managing R&D, of course, require specially trained personnel, too."

The Manpower Resources section of Chapter IV draws heavily from the manpower report by Clark and Hopkins (1969) in summarizing previous relevant studies.

Clark-Hopkins 1969 Study

In reading the first two appendices the reader will note some overlap in the content of the literature cited, but Appendix B focuses in greater detail on those studies bearing directly on estimates of educational R&D personnel supply including a succinct description of how Clark and Hopkins (1969) established their base estimate of 4,125 R,D&D personnel in education in 1964. Gideonse does not discuss the method of projection employed by Clark and Hopkins. Because this method is one of the most defensible we found, it deserves careful examination. For a brief summary we turn to Hopkins's own description (1971, pp. 2-3):

> "Very briefly, the procedures used in the 1969 Clark-Hopkins report were the following. Basic data regarding personnel supported in RDD positions were obtained from those FY 1966 proposals which had been approved for funding. Financial data (appropriations, expenditures) were available through FY 1968, in most cases. Program administrators in eight USOE divisions and one NSF program were interviewed to obtain their perceptions of the growth of their program through FY 1974. Using this base data and logically derived extensions of the data, three projections were made of anticipated funding in FY 1974: A least optimistic one, a most optimistic one, and a most likely one. Financial projections were transformed into personnel projections through the use of a "growth ratio," the amount of money projected for 1974 (taking into account inflationary trends) divided by the amount of money actually available to support a given number of people in 1968. If the growth ratio was one, exactly the same number of people could be supported in 1974 as were

> supported in 1968. Personnel demand was projected along three dimensions: institutional setting, professional assignment and RDD function."

After reviewing alternatives for making projections, the present writer remains impressed with the approach taken by Clark and Hopkins; and, as the reader will later see, has built into the recommended survey design the potential for obtaining a more accurate and comprehensive base of information about critical RDD&E subpopulations. Such information can be used to make projections based on financial data, using fundamentally the same procedures employed by Clark and Hopkins. Consequently, it is recommended that the survey contractor examine the details of the Clark and Hopkins report.

It will be seen in Appendix C that the Far West Laboratory (Hood, et al, 1970) concluded that Clark and Hopkins were both more "optimistic" and more "narrow" than seemed warranted, based on 1970 information. Comparison to data supplied by Gideonse (1969) and 1970 funding information suggested that the Least Optimistic estimate of a threefold increase 1964-1974 was more likely than their Most Likely estimate of a five fold increase. We also argued that surveys to date have failed to take account of the total national demand for educational, training and social systems RDD&E personnel and that there has been an almost complete failure to take into account the potential role of the trained paraprofessional. Our survey of the Bay Area indicated that if industrial and business training, and other social science RDD&E employment, are considered, there is a substantially larger labor market which provides on-the-job training experience and competes for the same kinds of trained talent.

Hopkins's 1971 Updating

John Hopkins (1971) updated the 1969 Clark and Hopkins study. Hopkins notes that since publication of the first study, economic and political shifts have occurred which make the original projections overly optimistic. Since, as Hopkins notes, the earlier study was the most comprehensive--indeed the only--financially based projection of demand for trained personnel in education, the update was based on actual funding through 1971 and on current administrative conception of the future of RDD&E activity through 1974.

Hopkins's summary of the method employed in the original study has been quoted previously. It may be useful to note his remarks regarding the limitations of the 1969 Clark-Hopkins report:

> "1. When the original data were gathered, evaluation personnel were not identified as a separate group as were research, development and diffusion personnel. There is no projection, therefore, of the demand for or influence of this visible and important group.
>
> "2. The heady atmosphere which prevailed after the passage of the Elementary and Secondary Education Act (ESEA) in 1965 resulted in some of the original projections being so

> optimistic that they bear little relationship to the current situation.
>
> "3. The projections were based on the number and types of positions listed in the budgets of funded proposals, on the assumption the project directors would actually employ the number and type of personnel cited in their budgets. No follow-up was made, however, to determine what personnel were actually employed to carry out the projects and thus to determine the validity of the assumption,
>
> "4. The possibility of retraining professionals from fields other than education to meet the supply deficit in education was not fully examined." (Hopkins, 1971, p.3)

Unfortunately, the updating was not able to include educational evaluation and indeed provides no discrimination among research, development and dissemination. The two very specific objectives were: (a) to update (not replicate) the projections of demand made in the original study, and (b) to test the validity of the assumption that the number and types of positions listed in budgets of approved proposals would correspond to the numbers and types of personnel actually employed.

The report is meticulous in detailing its limitations and methodology. Passing on to results, Hopkins emphasizes the point that the reader, in interpreting the results of the original report on the update, should focus chiefly on the magnitude of the differences in positions over time, rather than upon the specific number of positions or precise differences. "The projected numbers are imaginary. They are used only to indicate to program planners, administrators and directors the direction and scope for which they should develop contingency plans" (Hopkins, 1971, p. 12).

Hopkins's updated projections are summarized in Table 1.

Hopkins observes that the original study identified 4,125 persons in 1964, and suggests that most of the 8,669 positions projected to be needed by 1974 are already filled. The reasons given for his assumption are that (a) the economic indicators suggest that since 1966 there has been little expansion in the number of positions available, and (b) funding program administrators do not see any marked increases in funding for support of new positions in the near future.

These results suggest that the approximate number of professional RDD&E positions may be at least 8,000 in 1972. It should be recalled that both the Clark and Hopkins (1969) and the Hopkins (1971) reports provide estimates on numbers of professionals. Reliable information on paraprofessionals is hard to locate. Appendix C of this report and NSF data cited later provide some information. Another possibly useful, if limited source of information on staffing patterns is found in the Case Profiles of the Oregon Studies (Teaching Research Division, 1971-72), also discussed later.

Table 1

Projected 1974 Positionsiin Educational R,D&D

Sub-Units (Federally Supported)	Projected Position	Other Settings	Projected Positions
Regular Projects	991	Schools and colleges of education	1,244
Laboratories	564	Other behavioral and social science departments	527
Title III Centers 6%	469	Schools and departments of Psychology	500
State Educational Agency Res. Units	361	Other discipline and academic departments	491
Small Projects	354	State Departments of Education	457
R and D Centers	307	Business and industrial organizations	300
NSF Course Content Project	216	Private research institutes and agencies	300
Handicapped Materials Centers	193	Schools and school systems	270
Clearinghouse	180	College and unicersity administrative units	205
Vocational Education Research Coordinating Units	177	U.S. Office of Education	156
Handicapped R&D Centers	127	Professional associations	90
Vocational Education R&D Centers	88	Inter-agency Associations	50
Early Childhood Centers	39		
Policy Study Centers	13		
Total positions Federally Supported	4,079	Total Positions Supported from other Sources	4,590

Final Projection of Positions	[a]8,669
Estimated Research Positions	[a]2,861
Estimated Development Positions	[a]4,334
Estimated Diffusion Positions	[a]1,474

[a] Figures based on proportions projected in the original Clark and Hopkins study (1969, p. 288) of: research, 33%; development, 50%; and diffusion, 17%.

The second aspect of the Hopkins update study is of special technical interest with respect to projections from proposal and funding information. Hopkins found in a follow-up survey of grant and contract performers that there were relatively few significant changes between staffing descriptions contained in proposals and the actual staffing patterns. His study was based on a sampling of 46 projects with 37 (80%) usable returns.[4]

AERA Studies

There are several studies recently published or soon due to be published which deserve attention. The USOE-sponsored AERA Task Force on Training Research and Research-related Personnel, sponsored by the Research Training Branch, USOE, has produced a large series of papers (1970-71). The update by Hopkins (1971) cited earlier is Technical Paper No. 25 in this series.

Brzezinski and Smith (1971) are authors of Paper No. 26: A Review and Synthesis of Studies on Manpower Supply and Demand in Educational Research, Development, Diffusion and Evaluation. This report stands along with Gideonse (1969) and Clark and Hopkins (1969) as a highly recommended "starting point" for an overview of the problem. The report contains a brief description of twelve selected studies and then a synthesis of findings regarding: (a) personnel presently in educational RDD&E, (b) manpower pools available for recruitment into educational RDD&E, (c) present trainees in educational RDD&E, and (d) future RDD&E personnel needs.

Regarding future needs, Brzezinski and Smith observe:

> "The one central thread which runs through the results of all these studies is the equivocal nature of the data reported. Collectively, these data do not provide much guidance for the trainer of RDDE personnel." (p. 47.)
>
> "One thing which might be said with some degree of certainty . . . . is that future manpower needs will be tied much more directly to funding levels for educational RDDE than to educationists' perceptions of how many RDDE personnel are needed." (p. 48.)
>
> "In summary, the current data base on future supply and demand of educational RDDE personnel is simply much too shaky to support any firm projections; indeed they defy any meaningful analysis. Carefully controlled studies of educational RDD&E manpower needs and supply are necessary before any real direction can be provided to trainers of RDDE personnel. In the absence of such studies, trainers of necessity will have to combine their best interpretations of data such as those discussed in this section with judicious use of the crystal ball to determine

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[4] In Chapter of this report is a recommendation that lists of project employees derived from budgets of funded proposals be submitted to employers for updating in order to create employee sampling frames. If this recommendation be followed, a special study of a sample of the updated changes could be undertaken to confirm Hopkins's findings.

> how many and what type of personnel should be trained in educational RDDE." (p. 49.)

Smith (1971) is the author of Paper No. 27: A Review and Critique of Studies of Educational RDDE Training. This is a 290-page compendium of 39 studies which have been meticulously selected, described and critiqued. Smith, Anderson and Gephart (1971) are authors of the companion Paper No. 28: A Synthesis of the Results of Research on the Training of Research and Research-Related Personnel in Education. Although the scope of these two papers extends well beyond the immediate concerns of survey design, they do contain relevant information regarding professional work of researchers, functions and competencies considered important by RDD&E supervisors, and substantive content of training programs. Taken together they undoubtedly qualify as the most convenient, up-to-date, rigorously selected and comprehensive source of such information now available. The content and import of the synthesis document by Smith, Anderson and Gephart is best stated in their own summary:

> "This review of information on the training of educational researchers is limited to the results of research which have passed tests of methodological adequacy. Included are studies on the characteristics of educational researchers and their professional work and studies involving training variables, such as the selection of trainees and trainee characteristics, the goals and nature of training programs, and the institutional setting for the training of researchers. It is clear from the studies identified that there is an abundance of information on some of the topics listed above and a major deficit in others. Information is available on which to base descriptions of the individuals who are educational researchers. Information is also available to describe the institutional settings in which the majority of the training effort is concentrated. Finally, information is available with which to describe the general nature of the research process. Major deficits exist in the areas of manpower needs, the specific nature of training, and the nature of training needs in the research-related roles of development, diffusion and evaluation. (Emphasis added.)
>
> "Studies are needed which answer the following questions before long-range planning can be effected for a system for educating the research and research-related personnel needed in education.
>
> 1. What are the continuing manpower needs in the following roles in education:
>
>   a. Production of broadly generalizeable knowledge about the process of education;
>
>   b. The creation of the products and procedures needed for the conduct of education;
>
>   c. The distribution of information among the various specialties in the education system; and,

    d. the generation of evaluative information about educational products, programs, and processes.

2. What are the specific concepts and skills that are needed to perform in each of these roles? (The answer to this question must go beyond the boundaries of empirical technique; the method of research encompasses more than sampling, measuring, and analyzing data. The same is true for the other three roles.)

3. What procedures are effective in assisting students to the mastery of the concepts and skills referred to in question two?

> "The answers to these questions should not be considered as static items, once determined, to be true for all time. A vehicle is needed to obtain the information initially and to continually update and refine that store of information. Without a continuing vehicle, the effort to answer the questions suffers from a time constraint which will make the information produced of questionable value within a decade.
>
> "The process of preparing educational research and research-related personnel is a complex effort which defies summary in a short summary section. To attempt to do so would do injustice to the topic. What is known with some degree of surety is presented in the preceding pages. What is not known is suggested in the questions above." (Smith, Anderson and Gephart, 1971.)

Training Programs and Trainees. Technical Report No. 13: An Analysis of Characteristics of 1969-1970 Trainees in Title IV Graduate Research Training Programs and a Comparison with Sieber's Study of 1966-67 Trainees, by Hopkins, Worthen and Soptick (1970) found that the 1966-67 and 1969-70 trainees were very much alike, the most notable differences being that the 1969-70 group was (a) younger, (b) more frequently recruited directly from previous degree programs, (c) from a much broader disciplinary base, (d) more frequently recruited from positions which involved some research activity, (e) more likely to seek the Ph.D. rather than Ed.D. degree. The report indicates that approximately two-thirds of the doctoral programs were at institutions cited for the quality of their research and that the 1969-70 trainees, as a group, showed "GRE and MAT scores on a par or higher than the scores received by a majority of students in virtually every professional and substantive field referenced."

The Hopkins, Worthen, and Soptick report basically is limited to the data reported on OE Form 6003 (8-69) and a supplemental program director form. Unfortunately these forms fail to elicit any direct information on the content or extent of training (e.g., how many of the 797 trainees identified in this study have acquired competences useful in educational evaluation beyond research design, tests and measurement, or statistics). This deficit is met by the Byers report which is discussed next.

While the technical Report No. 13 focused on trainee characteristics, Technical Report No. 24: A Survey of Existing Training Opportunities In Educational Research and research-Related Areas by Byers (1971) focused in program content and degree production figures based on information gathered from 83 degree granting institutions (out of 405 responding to the query) and 55 other organizations and agencies[5] regarding educational research and research-related training opportunities.

Information reported by the degree granting institutions shows that at the end of the 1970-71 academic year there were 707 sub-doctoral (48% full-time), and 1,053 doctoral students (62% full-time) enrolled in educational RDDE programs. Employing Clark and Hopkins's (1969, p. 305) assumption that one half of the full-time subdoctoral students and one-third of the full-time doctoral students receive their degrees each year, Byers suggests that the existing educational research programs are producing between 350 and 400 graduates (approximately 170 subdoctoral and 219 doctoral) each year from their full-time students alone. [An additional 100 to 150 may be graduated annually from the approximately 750 non-full-time students--which suggests a total approaching 500 annually, probably divided nearly evenly between subdoctoral and doctoral graduates.]

Regarding content Byers concludes:

> "In terms of areas of emphasis, the graduate programs in this study focus overwhelmingly on research methodology, measurement and evaluation. Only a handful of programs place major emphasis on educational development or dissemination and diffusion.
>
> "The same is true, to a very large degree, of the 55 non-degree granting organizations which regularly offer research-related training. Evaluation is by far the area of greatest interest, as indicated in the workshop, seminar, institute and conference topics listed by the respondents. This is true not only in state education departments, where ESEA Title I and Title III evaluation requirements must be met, but also in R&D centers and laboratories and in the regional education councils. The areas of management, development and dissemination fall well behind in the topics listed.
>
> "Somewhat more than half of the non-degree granting organizations consider the major focus of their training program to be the updating of earlier training rather than in-depth instruction in areas new to the participants. The lack of emphasis on in-depth training is probably also reflected in the fact that only eight of the fifty-five responding organizations have regular training activities of more than five days duration. It is also true that over half of the organizations, through internship arrangements with colleges and universities, provide opportunities for

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[5] The non-degree agencies and organizations included 19 SEA's, 9 R&D Centers, 19 Laboratories, 7 private R&D organizations and one USOE Bureau.

> practical experience in educational research and research-related areas. This underscores the apparent role of the non-degree granting organizations as facilitators--rather than major instigators--of research-related training.
>
> "Since the major purpose of the effort reported in this paper was to gather information for the directory of training opportunities, it was not anticipated that the data which have been described would yield any major conclusions. Nevertheless, three very general comments seem appropriate. First, the colleges and universities are preparing a respectable number of students in research methods and design, measurement and evaluation. Second, other organizations conduct training activities in response to the felt need of their staff and clients; at present, the major need for such training seems to be in the area of educational evaluation. It may be that universities and colleges need still more emphasis on training in this area. Last, among the groups surveyed there appears to be no major effort underway for the training of educational developers and disseminators." (Byers, 1971, pp. 34-35)

The findings with regard to training program content are generally consistent with previous studies (e.g., Buswell, et al, 1966; Millikan, et al, 1966; Millikan, 1967; Sieber and Lazarsfeld, 1966; York, 1968; Fleury, Cappelluzzo and Wolf 1970), with the possible exception that the AERA survey suggests a marked increase in interest in evaluation.

The Byers report is of more than passing technical interest for the proposed survey design, since it provides an obvious and commendable point of departure for any further survey of educational RDD&E training, both in terms of sampling frames and questionnaire development.

The last two AERA reports suggest that there may be some noticeable improvement in educational research and evaluation (R&E) training both in quality of programs and quality of students. Assuming a yearly production approaching 500 graduates nearly equally divided between doctoral and subdoctoral, in 83 programs, we may assume an adequate degree-production base for educational research. This is less evident for educational evaluation since we lack specific information on the number receiving "adequate" evaluation training. An adequate degree production base for educational development and dissemination does not yet exist.[6]

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[6] The Byers (1971) study shows, out of 259 areas of emphasis in 83 programs, only 10 programs offered "educational product or program development" and 4 programs offered "dissemination and diffusion" as areas of emphasis. The earlier study by Fleury, Cappelluzzo and Wolf (1970) which was confined to a survey of the 85 educational research training programs then supported by USOE, found 80 with research emphasis, 20 with development emphasis and 5 with diffusion emphasis.

Tasks and Competencies. Because one area of concern expressed by the staff to the Research Training Branch was that the proposed survey deal with the cluster of competencies required by RDD&E personnel in different functional areas, the AERA Task Force Technical Paper No. 23: An Analysis and Interpretation of Tasks and Competencies Required of Personnel Conducting Exemplary Research and Research-Related Activities in Education by Anderson, Soptick, Rogers and Worthen (1970)is worthy of notation. The study is based on 116 interviews (103 personal contact and 13 by telephone) with persons identified as being engaged in exemplary R,D,D or E activities. The persons were selected within organizations that have a broad scope and focus on more than one of the four functional areas (RDD&E). Personnel at several levels were interviewed to obtain data about actual tasks performed and competencies required in the interviewee's day-to-day job performance. Interview data was coded into a set of 69 logically formulated task categories (specific activities) and 226 competency categories (specific knowledge and skills used to engage successfully in a task). Following check of inter-coder reliability, a factor analysis was used to isolate 12 task factors or "functions". Factor analysis and additional empirical-logical procedures were used to identify seven competency factors. Relationships among competency factors, task factors, and the commonly used categories are discussed and the results of the statistical analysis are presented.

The results indicate a set of relationships among competencies, tasks and conventional functional categories which appear reasonable, but are markedly more complex than suggested by the descriptive literature.

The results of this factor analysis and a "complementary" one performed as part of the Oregon Studies (Teaching Research, in press) which used an inverse factor analysis to establish person factor"types" based on between-person similarities in ratings of extent of involvement in RDD&E activities, may provide an adequate beginning of an empirical base for the question of competency clusters.[7]

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[7] Initially, we were unaware of the AERA factor analysis study, and had designed and begun field testing of four alternate employee questionnaires totaling 94 task items. Reactions by field test respondents were unfavorable and the effort was abandoned in favor of a shorter 25-"function" RDD&E profile. Factor analysis of this profile data along with other questionnaire items is a possibility. The results would be at an admittedly much grosser level than the 69 tasks or 226 competencies employed in the AERA study, but the linkage with other questionnaire data could place the 25 functions in the context of other possibly relevant information regarding the project and the person. The terms and concepts employed in the 25 function RDD&E profile can be easily related to the AERA data.

The Oregon RDD&E Studies

An unusually rich source of in-depth information will be found in the Case Profiles of the Oregon studies (Teaching Research Division 1971-1972). These studies, also sponsored by the Research Training Branch, USOE, include: (a) a set of four commissioned position papers and a number of related critiques regarding current conceptions of educational research, development, dissemination and evaluation and their relation to each other; (b) a sizable compendium of articles and papers which have been selected to represent current thought on theoretical and practical aspects of educational RDD&E, as well as nearly every permutation of these four areas of activity; (c) a set of 20 case profiles of selected educational RDD&E projects; and (d) a summary report.

In terms of information about content, organization, staffing, personnel activities and requirements, tasks and subtasks, product and by-product, as well as perceived requirements for knowledges, skills, and sensitivities, the data base is voluminous. Most of the case profiles are flawed in their analysis, with too much uninspired reporting of meticulously collected detail and too little effort at "clinical" integration of the detail or interpretation of what it means. But the Oregon case profiles provide a much needed base for understanding the possible contents for educational research, development, dissemination, and evaluation. The summary report should be read and the case profiles at least sampled.

The Minnesota RCU Survey

Paul Schroeder, at the University of Minnesota Research Coordinating Unit for Vocational Education is now conducting a mail survey employing an extensive questionnaire on RDD&E activities which is apparently based on both AERA and Oregon instruments and findings. The Schroeder study, like nearly all others, is flawed in its dependence upon voluntary information submitted by personnel who have been contacted in such a variety of ways that it seems almost impossible to make any kind of satisfactory population estimate for other than the sample itself.

The I.E.D. Study of State Departments of Education

Undoubtedly one of the most useful and complete recent surveys is the survey of RDDDE in state educational agencies (SEA's) conducted by the Institute for Educational Development (IED) under the supervision of Henry Brickell (1970)[8]. The Brickell study promises to be unusually useful and complete. It is based on visits to 12 geographically representative states known to be active in R&D (California, Colorado, Georgia, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Texas, Utah and Wisconsin); mailed questionnaires to all SEA's probing into the organization, financing, staffing and content of state activities not only in research units but throughout the agency; and meetings at the nine regional USOE offices in which research personnel from 31 states participated to discuss the situation in their own departments.

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[8] Brickell (1970) provides a description of the study and a report of early findings. The complete report may be published early in 1972.

Based on a December 1971 telephone conversation with Henry Brickell, approximately 40 of the 50 states had responded and about 30 provided nearly complete information. Most notably, the study includes questionnare returns from approximately 400 persons engaged in RDDDE in SEA's.

The preliminary report (Brickell 1970) indicates that about 50 percent of SEA RDDDE personnel are supported by federal funds, about 70 percent are under 40 years of age, and at least 80 percent have held their present positions for two years or less. Most departments have difficulty in finding and adding skilled RDDDE staff members. About one third of the staff were recruited from school districts, one third from other positions in the RDDD&E unit itself or elsewhere in the department, one sixth from universities and one sixth from other sources. New staff members brought in from school districts are seldom "retooled" for RDDDE tasks. Most recruiting is through friends and acquaintances of the existing staff. Those who stay are not as well educated as those who leave (80 percent of those leaving had graduate degrees compared to 60 percent of those staying; 40 percent of those who left held doctorates as compared to 20 percent of those who stayed). Seventy-five percent of those leaving gave career advancement or higher salaries as the reason. About one third of the states report providing some kind of training, usually for department personnel, but in some cases for others.

This personnel and training picture in the SEA's is laid against an overall organizational, financing, and staffing picture which Brickell describes thus:

> "State education departments have come out of the 1960's somewhat improved but not remade. Their ability to perform or to stimulate and support research and development and related functions has been strengthended somewhat, largely at federal initiative and with federal funding. Yet no state education department enters the 1970's with satisfactorv organization for RDDDE, with sufficient staffing, or with adequate funding either from state or federal sources."
> (Brickell 1970, p. 133.)

No survey of RDD&E personnel and training requirements in SEA's should be undertaken until this forthcoming report is examined in detail. Probably the only major type of information which is missing from this very comprehensive study is highly specific information about needed or desired training content, although much of this may be inferrable from other data.[9]

Anyone who would attempt to interpret educational RDD&E survey data would do well to read the Oregon Studies and the AERA series as well as the forthcoming Brickell report.

Existing Sources of Information on Scientific R&D Personnel

Surveys by Other Federal Agencies

National scientific-personnel information, until 1970, was derived from three primary sources: the Bureau of the Census, the Bureau of Labor Statistics, and Surveys of the National Science Foundation, including the National Register of Scientific and Technical Personnel and surveys of R&D institutions. Each of these sources yields different information because of differences in methodology, definitions, and time references. The 1970 Census of Population should provide a current estimate of scientific and technical population classified according to the Census occupational classification. This classification system, although quite comprehensive, is not sufficiently detailed to identify educational RDD&E personnel. The Current Population Survey of a sample of households, which is conducted monthly, provides insufficient occupational detail. The Office of Education could arrange to have one or two questions inserted but the sample is too small to provide useful estimates of such a very small part of the work force as educational RDD&E.

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[9] The Individual Questionnaire: Personnel and Professional Background includes complete identification by name, title, administrative unit, address and telephone, sex and age. The content questions are percent time involved in each R,D,D,D, or E; educational level, nature of present position, time in present position, source of funds for present position, type of previous position (e.g., another state department, a college or university); "how you first heard of first position in the department," "who strongly influenced your decision to join the department," "was he a friend?" total work experience in each (R,D,D,D, and E); and activities during past five years.

The Administrators', Budget, and Project or Activity Questionnaires contain additional pertinent information. Items of specific training relevance are II. D.4 (Is technical assistance available upon request for training of staff in each of R,D,D,D, or E?) and VI Training ("Please describe any especially interesting or effective training of specialists in research, development, demonstration, dissemination, or evaluation sponsored or carried on by this administrative unit.")

The Bureau of Labor Statistics prepares annual estimates of the gross number of natural scientists employed, by broad occupational groups based on surveys of employing establishments. The BLS occupational definitions are again too broad to pinpoint educational RDD&E, lack detail on employee characteristics, and the survey probably misses many establishments, such as local educational agencies, where educational RDD&E personnel may be employed.

The National Register

The National Register (NSF) was, until its demise in 1970, the most useful of the three sources because it provided much greater detail on the field of science and sub-specialities, educational level, current employment and work activity, salary and income and other information. The register is unique in that it contains a quarter of a million records which have been matched for at least two points in time for 1954, 1956-58, 1960, 1962, and 1964. If resources permit, this matching effort can be extended to 1966, 1968 and 1970. The major weakness of the National Register is its incomplete coverage. Only that portion of the scientific community is reached which is identified by mailing lists of the cooperating professional association. In 1968, 66 percent replied and 16 percent of the questionnaires which were processed were either incomplete or failed to meet the criteria for full professional qualifications set by the professional associations. Hence the National Register data, although the richest single data source available, is flawed by its incomplete coverage, and for the purposes of a survey of educational RDD&E by the fact that education *per se* is not considered a scientific or technical field and appears only as a federally funded program area.

Many personnel holding doctorates in education probably would not be in the register. Although the National Register does not provide direct information on educational RDD&E personnel and, in fact, does not survey the field of education (except as a federal funding source) at all, it does provide a wealth of "context" information regarding related scientific disciplines.

Federal support. For instance, respondents to the 1968 Register were asked, "Is ANY of your work being supported or sponsored by US Government Funds?" and to indicate whether their work was *related* to agriculture, atomic energy, defense, education, health, housing, international, natural resources, public works, rural development, space, transportation, or urban development programs. There were 127,415 individuals who reported receiving support, with 37,036 reporting support for more than one program area. For the educational program area, there were 18,817 respondents and of these 4,607 reported that their primary work activity was in research and development or design but *not* management or administration of R&D). An additional 2,418 indicated their primary work activity was management or administration of R&D.

When we look at the scientific fields of those reporting that their primary work activity was R&D or management/administration of R&D, *and* that any of their activity was funded by governmental programs related to education we find the distributions in Table 2.

The table shows that slightly more than a third of the respondents report their primary work activity as management or administration of R&D (2,418) and the remainder as basic research, applied research or development (4,607). This proportion of managers and administrators is somewhat higher than for all fields (disregarding whether education-related or federally funded).

Table 2

National Register (1968) Personnel Reporting ANY of their Work Supported by U.S. Government Funds Related to Education, and their Primary Work Activity as Research and Development.

	Scientific Field	Nr. Primary R&D	Percent of Fields	Nr. Management or Admin. of R&D	Percent of Fields	Total Nr.
1	Psychology	1,380	29.9	654	26.7	2025
2	Chemistry	954	20.7	218	9.0	1172
3	Biological Sciences	678	14.7	438	18.1	1116
4	Physics	537	11.7	260	10.7	797
5	Mathmatics	216	4.7	222	9.2	438
6	Sociology	246	5.3	129	5.3	375
7	Economics	109	2.4	126	5.2	235
8	Earth and Marine Sciences	142	3.1	84	3.5	226
9	Computer Sciences	92	2.0	61	2,5	153
10	Linguistics	55	1.2	18	0.7	77
11	Political Sciences	49	1.1	64	2.7	113
12	Agricultural Sciences	46	1.0	64	2.7	110
13	Atmospheric and Space Sciences	40	0.9	47	1.9	87
14	Statistics	35	0.7	28	1.2	63
15	Anthropology	28	0.6	14	0.6	42
	Total	4,607	100.0	2,418	100.0	7,025

Note.--Extracted from NSF-69-38, Table A-40 (pp. 182-189).

The record for all fields shows 23 percent (28,564 persons) as managers or administrators versus (77 percent 96,036) R&D scientists other than management. The higher proportion of managers and administrators receiving education-related federal funds may reflect the smaller scale of educational R&D projects, which results in proportionately more principal investigators than in other fields.

Probably the most remarkable thing about the table is the great variety of scientific and professional disciplines represented.

Since psychologists are the largest group represented it may be instructive to illustrate some of the additional information we can find in the National Register regarding this subfield. In 1968, a total of 23,077 psychologists registered. Of these 5,975 were in research and development as their primary work activity, and 1,380 of these indicated their work received federal support related to education, so approximately one fourth (23%) of the registered psychologists who were primarily engaged in R&D received some support from federal programs related to education. Tables for discipline by degree by primary work by federal funding programs are not available, but examining the academic levels of the total 5,979 in Research and Development we find 3,136 (52%) held doctoral degrees, and 2,771 (46%) held master's degrees.[10] Of the 1,380 psychologists with primary R&D work activity receiving federal education funds, 543 indicated primary activity as basic research and 1,323 as applied research.[11]

We may examine the psychologist field in yet another way by noting that the 1968 Register includes 2,379 educational psychologists, of whom 537 indicate primary work activity in R&D and 258 indicate management of R&D. There are 2,138 school psychologists, of whom 1,237 indicate primary work activity in R&D and 40 indicate management of R&D. Less than 3 percent of the educational and school psychologists indicated their primary work activity was basic research, while 94 percent indicated it was applied research (including clinical research/investigation, equipment or systems research, test development and administration, or interpretation of psychological tests). The residue is in development. We note that the number of educational and school psychologists in primary R&D activity exceeds the number of all psychologists in R&D with federal education funds

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[10] Psychologists with bachelor's degrees totaled 64, three reported professional medical degrees, and five gave no answer. The number of psychologists with the bachelor's is under-represented because the American Psychological Association criteria for inclusion in the national register required completion of two years of graduate work or a master's degree with one year of professional experience.

[11] The combined totals for basic research and applied research exceed the total in research and development. Individuals were asked to mark their first and second most important activities.

(1,774 vs. 1,380) but educational and school psychologists with primary activity as R&D managers are far fewer than all psychologists who indicate management of R&D and federal educational funding. Obviously other psychology subdisciplines are involved in education-related federally funded programs, but this data has not been published.

We can look at subdisciplines in terms of degrees (e.g., of a total 2,379 educational psychologists, 1,510 held doctorates, 859 master's, 9 bachelors, and 1 did not report degree, Table A-48); type of employing organization (e.g., 1,895 educational psychologists were employed by educational institutions, 47 by federal government, 102 by other government, 165 by nonprofit organizations, 64 by business and industry , 10 by military; and 23 were self-employed, 34 were not employed, 26 "other", and 13 no report (Table A 49A). Other tables give numbers of personnel separately by science subfield; by doctorate, master's, or bachelor's degree; by age, years of professional experience, full-or part-time employment and geographic location. Salary data is presented by similar categories.

Other disciplines represented in Table 2 can be examined in a similar fashion to gain some understanding of the current supply of scientists receiving federal funds related to educational programs. Unfortunately the most-needed data would be presented in a finer analysis than is currently published of these approximately 7,000 scientists. Of particular interest would be the interdependence between the 1970 lists of the National Register for educational federally-funded personnel and the 1970 membership list of AERA.

NSF Institutional Surveys

The National Science Foundation annually or biennially surveys the personnel and financial characteristics of Institutions of Higher Education, Federally Funded Research and Development Centers and Medical Schools as they relate to the sciences and engineering. Each institution is requested to supply data on the number of scientific and technical personnel engaged in scientific and engineering activities, the total current expenditures for separately budgeted (i.e., organized) research and development; current expenditures for instruction and developmental research in the sciences and engineering, and relevant capital expenditures. The classification (1971) does not include educational RDD&E personnel *per se* but does include life scientists, psychologists (including educational psychologists but not separately identified) and social scientists, including separately identified economists, sociologists, political scientists, historians, and "other social scientists" (including but not separately identified: anthropology, linguistics, socio-economic geography and research in education). Data is reported separately for full-time and part-time personnel, and graduate students receiving compensation for services as scientistists and engineers. The number of "social science technicians" (as opposed to engineering, physical sciences, biological sciences and medical-and health-related technicians) is also reported.[12] Budgetary information is requested by source of funds, type of R&D activity, and capital expenditure for major fields of science. The financial data on current expenditures in instructional and departmental research are intended to be consistent with the USOE report "Financial Statistics of Institutions of Higher Education."

FFRDC data summarized. The data on the Federally Funded Research and Development Centers (FFRDC's) are of special interest since they provide separate uncontaminated[13] summaries for educational laboratories and educational R&D Centers, as presented in Table 3. Unfortunately, NSF funding only permits biennal surveys, with Non-profit FFRDC's (laboratories) and university-administered FFRDC's surveyed in alternate years. The data in Table 3 is the latest published. While the data in the two NSF reports on which the Table 3 is based are not completely comparable, the following observations seem valid. Both the Laboratories and the R&D Centers are staffed predominantly by social scientists and psychologists (89 percent for Laboratories and 97 percent for R&D Centers). The Laboratories tend to employ proportionately larger numbers of engineers, physical scientists and mathematicians. A substantial number of the scientists employed by R&D Centers are employed less than full time. Although graduate students are not reported for Laboratories, it may be assumed that they constitute a relatively small part of Laboratory staff; on the other hand, they represent approximately one-third of the FTE scientists and technician staff and nearly 43 percent of the scientific and technical personnel employed by the R&D Centers. The ratio of technicians to scientists is nearly twice as high at R&D Centers as at Laboratories. (And in either case, the ratio is markedly lower than the ratios for other types or FFRDC's.)

Conclusions regarding relationships between numbers of personnel and costs are markedly more questionable. If total numbers of scientists are used and dollars are adjusted for inflation there is a remarkable similarity: both the Labs and Centers show approximately equal figures: $36,000 per scientist in laboratories and $35,000 per scientist in R&D Centers in terms of 1969 dollars. However, as noted above there are marked differences

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[12] Technicians include all persons employed in positions which involve technical work at a level requiring knowledge of engineering or science (including psychology and social sciences) comparable to that required through formal post-high school training less than a bachelor's degree; but craftsmen (electricians, machinists, etc.) are excluded. This item may be of interest to those attempting to establish a scientist-to-technician ratio in the social sciences to compare with the ratio in educational RDD&E.

[13] FFRDC data are aggregated by major federal agencies. Fortunately the only FFRDC's sponsored by HEW are the educational laboratories and R&D Centers which are separately reported as non-profit and university administered.

Table 3

Employment and Financial Characteristics of Educational Laboratories and R&D Centers.
(Dollars in Thousands)

Personnel	Laboratories (January 1970)	R&D Centers (January 1969)
Scientists and Engineers		
Total Number	$902	$ 304
Engineers	14	3
Physical Scientists	26	2
Mathematicians	39	6
Life Scientists	23	293
Psychologists	160	
Social Scientists	640	
Full Time Equivalents (FTE)	Not Reported	229
Graduate Students		
Total Number	n.r.	266
Full Time Equivalents	n.r.	133
Technicians		
Total Number	100	52
Ratio to 100 FTE Scientist and Engineers	13.0	22.7
Finanacial Data year	(1969)	(1968)
Number of Labs./Centers	17	10
R&D Expenditure		
Current R&D Total	$32,288	$10,189
Basic Research	-0-	5,388
Applied Research	32,288	2,906
Development		1,895
Capital Expenditures	$5,061	$ 433

Source: "Scientific Activities of Independent Non-profit Institutions, 1970" (NSF-71-9), 1971, p.44, p.14 for personnal data on laboratories; "Resources for Scientific Activities at Colleges and Universities, 1969" (NSF-70-16), 1970, pp.128-129 for data on R&D Centers; "Federal Support to Universities and Colleges." (NSF-70-27), p.55 for Laboratory Capital Expenditures.

between the Laboratories and Centers in two and possibly three areas: (a) R&D Centers employ proportionately nearly twice as many technicians,[14] (b) R&D Centers probably employ proportionately many more graduate students[14] (apparently at approximately half time), and (c) R&D Centers employ more part-time scientists. (Unpublished 1971 R&D data show that the ratio of FTE Scientists to total scientists for R&D Centers shifted from .74 in 1969 to .83 in 1971, which is a marked shift to more full-time scientists. FTE data are not available for laboratories, but the assumption that laboratories employ more full-time professionals than R&D Centers seems tenable.)

More detailed information will be required before valid personnel to dollar comparisons are possible. The major value of the above dollar figure lies in its use in estimating numbers of professionals in relation to program budgets. Allowing for inflation at approximately six percent between 1969 and 1972 and allowing for the increasing number of full-time professionals, suggests that a figure between $40,000 and $42,000 may be useful in estimating the total number of professionals in educational laboratories and R&D Centers in relation to FY 1972-73 funding. Estimation of paraprofessionals is more difficult. Noting there were 133 FTE graduate students, which might be equated to "paraprofessionals," vs. 229 FTE scientists in R&D Centers, suggests a ratio of at least 58 paraprofessionals to 100 professionals.

Summary of Other Federal agency Information.

Several conclusions emerged from our examination of data and interviews with federal agency personnel.

First, it became clear that educational RDD&E was not a field that had been adequately covered in any U.S. Census, Department of Labor, scientific manpower, or similar government survey and that it was unlikely to be surveyed in the near future. U.S. Census and Department of labor surveys use categories that are too broad to pinpoint this relatively small and specialized vocational area.

Possibly the most promising source of information about reasonably current manpower is the national Register of Scientific and Technical Personnel. Regarding it there are several pertinent comments. (a) It was not funded in 1971 and is now defunct; the latest information is for 1970. (b) It does not identify educational R,D,D or E as scientific and technical fields; however, there are many specialty codes, particularly in psychology, which may be relevant. Education is specifically identified as a specialty or area of application for Anthropology, Chemistry,

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[14] Note that graduate students and technicians are reported separately from scientists.

Computer Science, Economics, Linguistics, Mathematics, Sociology and Statistics.[15] (c) The National register was just that, a voluntary register of scientific and technical personnel. Mailings were accomplished through cooperating professional associations (e.g., American Institute of Physics, American Psychological Association). Response rates were often in the 60 percent bracket.

The 1970 data could be used by the Office of Education either for analysis or as a basis for building sampling frames, but a formal request from USOE to NSF would be required, including full statements of intended use and justification. For mailing lists, the professional associations might be a better source since they would be more up-to-date.

The published reports of annual surveys of federal support to universities, colleges and selected nonprofit institutions can be used to locate specific institutional recipients and dollar amounts of HEW funds, but only in case of laboratories and R&D Centers, which are treated separately as FFRDC's, can we easily locate data on financial and personnel characteristics of USOE R&D funded activity.

Our study of U.S. Census, Department of Labor and National Register information leads to the conclusion that each can be useful in providing a background regarding R&D manpower in general, especially regarding gross numbers employed, geographical location, salaries, academic preparation, professional identification and employment, salaries and the like. But this data with the exception of FFRDC's is patently inadequate for pinpointing information about educational R,D,D or E *per se*.

Related Professional Association Surveys and Files

Because AERA is the major professional association for many educational RDD&E personnel, we checked with its headquarters personnel to determine whether they were conducting or planning to conduct any survey of its membership other than those under the auspices of the Task Force for Training. The answer was no, but they were as much interested in the proposed USOE survey as the Research Training Branch.

The Specialties List (1970 National Register) shows the following specialty areas and codes which seem particularly relevant: Educational Psychology, 6671--Curriculum development, 6672--Educational measurement, 6673--Educational technology, 6674--School adjustment, 6675--School learning, 6676--Special education, 6677--Student personnel, 6678--Teacher personnel, and 6679--Other (specify); Chemistry (Other Specialties), 5755 Education; *Anthropology*(Cultural/Social Anthropology, Ethnology, 6853--Education; *Economics* (Other Specialties), 7051--Education; Linguistics (Other Specialties), 7161--Education; and *Sociology* (Social Organization, Structure, and Institutions), 7322--Educational; Area of Application for Fields of Mathematics, Computer Science and Statistics, 18--Educational research.

Our next question was, had they anything similar to the National Register, or a listing of professional association members which would help to define the current RDD&E population. A new (1971) AERA directory is available. It is alphabetical, and contains name, title, address, job title, organizational affiliation, and divisional affiliations. AERA also has a mailing list, which can be broken down by divisions, and Zip codes. Each special interest group also has its own mailing list. These might be useful for pinpointing subgroups such as the Special Interest Group on Research Utilization. USOE would need, and could easily obtain, AERA Council permission to use the AERA mailing lists. As of January 1971 the AERA membership listed approximately 10,500 members and 6,000 subscribers.[16]

At the American Psychological Association (APA) we discovered that there were plans to launch APA's own survey similar to the National Register in 1972. A questionnaire was being pretested and a detailed plan had been drafted, but funding was uncertain. APA had mailed out to approximately 35,000 psychologists in the 1970 National Register, and received 27,000 responses, approximately 26,000 of which met APA criteria. APA hopes to build its list up to 54,000 by 1972. This list includes members, non-member subscribers to APA journals, and names acquired from state psychology associations, state liscensure and certification, regional psychological associations, and other psychology associations not in APA. If the APA survey materializes, it could be a valuable, up-to-date source for names of psychologists who identify themselves as (a) having a specialty in educational psychology, or (b) employed in federal-or state-funded educational programs.[17]

Other social science professional associations (e.g. American Sociological Association and American Political Science Association), according to APA staff, have also entertained efforts similar to APA's but there is no indication that there will be any significant activity in 1972.

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[16] AERA reserves the right to review all information to be mailed to a member or subscriber. Non-commercial organizations are charged $22.00 per thousand for 4 up Cheshire labels and $40.00 per thousand for pressure sensitive labels. Special selection requests, e.g., systematic sampling of specific divisions, could be done at extra charge. Mrs. Mimi Denis at AERA can supply information.

[17] A telephone conversation with Dr. Judith Cates, January 4, 1972 indicates that APA plans to go ahead with the data collection beginning in March. Their mailing list is approaching 60,000. They anticipate 40-to 50-thousand replies since the reply will be the only way to get in their directory this year. Data collection should be completed by mid-summer, but analysis is contingent on outside funding. A proposal is being submitted to NIMH.

The National Education Association (NEA) now runs a biennial survey of salaries in local public school systems. The survey contains information on "administrative research positions" in school systems enrolling more than 12,000 pupils. Of the nearly 400 school districts responding to the 1968-1969 survey (out of an estimated total of 532 districts), 57 percent reported no research administration position, 30 percent reported one position and the remaining 13 percent reported more than one position. This report is especially useful since it lists the districts reporting research administrators. The 1970-71 survey was currently underway and now available.[18] This latest report and the data behind it may be a prime source of information regarding school districts which have actually reported RDD&E positions.

NEA has also published reports of state department of education staff salaries. The 1969-1970 report identifies 157 planning and evaluation positions, 217 in research and statistics, and 58 information programs. Listings of research positions for each state are included, but are not very helpful due to the great variety of job titles.

The Institute for Educational Development provides a far more useful source of information regarding RDD&E in the state educational agency (SEA). This study is described in detail in the section on the IED study.[19]

Projected Supply and Demand

Interdisciplinary Participation

The problem of estimating future supply is complicated by the fact that an appreciable but currently indeterminate number of educational RDD&E personnel are recruited from a number of disciplines. While Byers (1971) queried 405 degree-granting institutions her query focused on the field of education. National Register data (NSF, 1969) show that in 1968 there were eleven scientific disciplines represented by more than 100 scientists each, whose primary work activity was in R&D or in management or administration of R&D, and who were receiving federal support for activities related to educational programs:

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[18] National Educational Association, "25th Biennial salary Survey of Public School Professional Personnel: 1970-1971 Data."

[19] The final report of the study may be published early in 1972. The only published reference is a chapter reporting early findings found in Morphet, E. L. and Jesser, D. L. (Eds.), Emerging State Responsibilities for Education, Improving State Leadership in Education Project, Denver, 1970.

Field	Number of Personnel
Psychology	2025
Chemistry	1172
Biological Sciences	1116
Physics	797
Mathematics	438
Sociology	375
Economics	235
Earth and Marine Sciences	226
Computer Sciences	153
Political Science	113
Agricultural Sciences	110

Other scientific fields represented by smaller numbers were Atmospheric and Space Sciences (87), Linguistics (77), Statistics (63), and Anthropology (42). Obviously the social, biological and physical sciences are all represented and in surprisingly large numbers. Basic research and science-curriculum-improvement programs are probably major causes for this amount of interdisciplinary participation.

It must be noted that the above data are (a) probably underestimated since they are counts of only the scientists in the National Register and (b) include part time effort since they are counts of scientists reporting ANY US Government support. However, they do illustrate the dilemma of estimating future supply. It patently is not sufficient to look at only educational RDD&E training programs as AERA has done, or at the Projections of Educational Statistics (1970 and earlier years) for only education and the social sciences as suggested by Gideonse (1969, p. 121).[20] On the other hand, in all fairness it must be noted that the National Register is a Procrustean source which can only accommodate those disciplines which fall within its science and engineering purview. USOE and NSF funding data (see Table 3) indicate that psychology and the social sciences are the major FFRDC recipients. Not only do scientists and scholars from a variety of disciplines contribute to educational RDD&E, they are also "converted" by switching from their degree specializations to an educational RDD or E specialization.

Field Switching. Available Office of Scientific Personnel data (1971) suggest the obvious conclusion that rate of switching between major fields is a rather gradual process amounting to possibly only a few percent a year. Over five years 1961-1966, 7 percent of psychologists had switched, with 3 percent entering mathematics and 1.4 percent other social sciences; In the other social sciences, 13.2 percent switched over the same five years with 3.5 percent moving into psychology, 2.6 percent into mathematics, and the remainder scattered at less than 1 percent among various other fields.

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[20] Gideonse (1969, p. 120) reports NSF data in his discussion of estimates of related RDD&E manpower, but confines his discussion to education and the social sciences (psychology, sociology, etc.) because of his "social science" definition of educational R&D.

The shifting between subfields, e.g., from botany to physiology within the bioscience field, is much greater, and particularly so with the development of new fields and the tendency toward greater specialization (Office of Scientific Personnel, 1971, p. 96). Accurate information regarding the disciplinary backgrounds, amount of field switching, etc. is quite meager for educational RDDE personnel. Survey data of educational RDD&E personnel should include information regarding degree major and past and current work activity to provide some estimate of at least the current recruitment patterns from various disciplines.

Eventually it may be possible to establish trend data (e.g., Hopkins, Worthen and Soptick, 1970, report recruitment of 1969-1970 trainees for ESEA Title IV Graduate Research Training Programs from a much broader disciplinary base than 1966-67 trainees). However, it should be remembered that program funding levels (e.g., NSF Curriculum Improvement Program) and policy (e.g., an NIE policy fostering interdisciplinary research in specific areas) could markedly influence trends in requirements for personnel with specific disciplinary training or experience. Data on disciplinary background and previous experience are probably most useful when they are examined in terms of the profiles of employee activity and competence and in terms of needed training vis a vis specific project functions and requirements. Numbers and rates are not as important as insight regarding recruitment potentials and training needs.

APA roundtable on advanced degree personnel. The results of our literature searches and interviews regarding supply and demand found focus in an APA-sponsored roundtable discussion on "Ph.D. Glut? Implications for the Behavioral Sciences."[21]

Allan Carter, Chancellor, New York University, indicated that doctoral training programs have a 7-to 10-year delay, graduate school enrollments had grown during the early 1960's by 14 percent a year, but the rate is now close to 4 percent. Since graduate R&D is 60 percent federally funded, we must look to federal program funding. He would project a modest 3 3/4 percent per year in the growth of funding over the next 10 years. The late 1970's and early 1980's could be a real problem for campus R&D when quite modest federal increases are met by a marked decline in the college age group. The pattern of response among departments to the current situation is different. THe physical sciences have already felt the tightening job market, but there has been increased undergraduate enrollment in the social sciences which could lull these faculties into a false sense of demand.

Robert Cain, head of sponsored surveys at the National Science Foundation, said NSF predictions for 1980 suggested a supply of doctorates in science and engineering of 350,000 as compared to 158,000 in 1969 (NSF, 1969).

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[21] American Psychological Association 79th Annual Convention, September 4, 1971, Washington D.C.

There is the possibility of a 40 percent greater supply than demand in engineering and 24 percent overage in the social sciences. His key point was that the patterns of utilization in 1980 for doctorates would be substantially different from those now exixting.

Betty Vetter, Director of the Scientific Manpower Commission,agreed that in the traditional sense there are too many Ph.D.'s. The physicists have been in trouble for two years. She predicted psychologists would feel the job pinch by June of 1972. She quickly added few will be unemployed, but they may not all find the kinds of jobs they were trained for.[22] The graduate pipelines are full and "bumping" is evident. The AA's and B.A.'s are most vulnerable, the M.A.'s less so and the Ph.D's least. Her major suggestions were that we change the type of doctoral training we provide and work at developing faculty and graduate student attitudes toward appropriate types of employment.

Thomas Kennedy, Jr., associate director for program planning, National Institutes of Health,made the point that manpower is a derivative of program and that how much will be invested in R&D is basically a political question. There are short-, mid-, and long-term problems in manpower projections. One can have some reasonable confidence in aggregate projections but it is very difficult to make disaggregate projections. The non-steady state transients, such as the cold war or our current concern with ecology and pollution, typically create big program pushes which typically end up with too many trained people. In the case of birth rates, they peaked in 1958 but were already in noticeable decline by 1961, just when the colleges were feeling the beginning of the surge. This kind of situation, where the error signal is delayed, can lead to typically severe over-corrections.

Alexander Astin, Director of Research, American Council on Education, noted that in the 1960's, Ph.D.'s could call their shots. The job market has changed, but the present isn't as dark as depicted--through there are clearly differential effects. Linguistics, sociology, computer science, political science and physics are all in bad shape but other fields such as psychology show a low rate of unemployment. Overall employment of doctorate holders in the sciences in Spring 1971 was only 2.6 percent. Referring to the latest (unpublished) report the employment situation for men Ph.D.'s is stable, but the situation for women has deteriorated.[23]

This is the current situation. If we look at the future we must first look at the over all economy. In Astin's view, most economists are "passive," focusing on anticipating need, and for them social action is a problem of adapting supply to demand. The "active" economist would attempt to adjust both supply and demand. It is Astin's belief, based on the performance of physical scientists in the 50's and biologists in the 60's, that the Ph.D. can create his own market.

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[22] Our interviews with Judith Cates at APA confirm this last point. APA placement studies show few Psychologist unemployed but many not satisfied with the positions they found.

[23] The effect of USOE prodding for equal employment opportunities for women on campus was not evident at that time.

The ensuing question and answer session revealed that there has been relatively little coordination in government approaches to manpower. There is now an interagency committee on scientific personnel and manpower headquartered in the Department of Labor.

With repect to psychology the point was made (and it is even more true for educational RDD&E) that there is hardly a subfield that does not have competitors. The employer has a choice of several other disciplines from which he may recruit; hence projection for a particular discipline on the basis of even good employer-demand projections is hazardous.

Derivation of personnel requirements from program. The literature on manpower projection is too voluminous to attempt to do it justice in this report. But Roger Bezdeck (1970) has provided some succint quotations which summarize the interviews with government agency and professional association personnel and reinforce the APA roundtable comments about manpower being derivative of program:

> "Industrial and occupational manpower requirements of the U.S. are in general highly sensitive to even very limited shifts in redistribution of national expenditures reflecting different priority commitments. . . .
>
> "Accurate and reliable manpower forcasting is currently impossible" [because of extreme sensitivity to even slight reallocations, and goals and national priorities can not be foretold with any degree of certainty]. (Bezdeck, 1970, p. 15)

The validity of Bezdek's conclusions for Educational RDD&E is hardly in question when one compares Clark and Hopkins (1969) with Hopkins (1971). The Hopkins updating (1971, pp. 7-9) is especially worthy of quotation:

> "There are now so many unknowns in the program administrators' environment that, for the most part, they were either unable or unwilling to project the course of their programs even a few years into the future. Their uncertainties about the effect of a National Institute for Education (if there is one), the health of the national economy, national priorities, and similar matters have produced a situation where only two of the administrators interviewed would state in specific terms where he was projecting his program to be by 1974. All of the others used such non-specific statements as 'The program probably won't grow very much.'
>
> "This was a remarkable change from 1966, when many of the same administrators were willing to project eight years into the future rather than two or three years. One effect of the administrator's unwillingness to be specific is that there is no basis for preparing a multiple set of projections which encompass the likely range of possibilities. . . ."

> "There is little doubt that the heavy infusions of funds from the ESEA of 1965 produced an enthusiasm which caused the original projections to be unduly optimistic. However, the extended financial starvation of the R and D programs since that time appears to have caused the program planners now to become unduly pessimistic in their views of the future."

If USOE program administrators exhibit this kind of reluctance, they are not alone. Preliminary informal contacts with USOE grantees and contractors, even at the relatively well established laboratories and R&D Centers, suggested that they were sufficiently uncertain about possible levels of future funding that requests for projections of demand beyond two years seemed unreasonable.

Some Conclusions Regarding Supply and Demand

1. Census, Department of Labor, National Science Foundation, National Academy of Sciences, and other sources provide a rich source of information about scientific personnel, but fail to pinpoint with the exception of the FFRDC's the relatively small sector of educational RDD&E.

2. Most previous surveys relevant to educational R&D have focused primarily on educational researchers and educational research training programs.

3. Within the past few years, several studies relating to educational development, dissemination, evaluation (and research) have been conducted (Hopkins and Clark, 1969; AERA Task Force, 1970-1971; Oregon Studies, 1971-1972; Brickell, 1970,[24] but none provide an adequate national probability sampling of current RDD&E requirements.

4. A survey involving the description of the current situation regarding educational RDD&E employers and employees is a fairly tractable problem, complicated mainly in definition of populations, securing defensible sampling frames, and problems of securing adequate response. The most serious limitation is probably budgetary, i.e., securing adequate funds to conduct the needed survey work.

5. Estimating current and short-term future supply and demand is more difficult. Demand is primarily a derivative of federal RDD&E programs, since most of the funding is supplied or stimulated by the federal sources (Gideonse, 1969). There have been several years of "level" funding in educational R&D, against a background of markedly dimished increases in federal funding in almost all R&D fields (NSF, 1970). Uncertainty among

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[24] Also Brickell, 1972 (in preparation).

Office of Education program managers regarding educational R&D funds is clearly indicated by Hopkins (1971). Information regarding the current supply in terms of degree granting and non-degree programs for educational R&D are best supplied by Byers' (1971) study which suggested that there may be a more than adequate current supply of educational researchers and an adequate number of programs to provide for a future supply. The predicted over-supply in most behavioral science fields suggests that basic educational research programs focusing on inter-disciplinary effort may not face major problems in securing researchers from various disciplines. (NSF, 1969b). On the other hand, the supply of educational evaluators vis a vis the demand is a less certain situation, probably with a much greater demand than supply. Several surveys including the most recent one by Byers (1971) confirm that there is currently a very low capacity for the training of either educational developers or disseminators. It can be anticipated that a national sampling survey would probably reveal structural shifts indicating a greater demand for development, dissemination and evaluation in relation to researchers, as projected by Clark and Hopkins (1969). To date, there is no reliable information regarding even the proportions or numbers in the four functional areas of RDD&E. There is a special need to pinpoint even more specifically numbers of persons, specific skills, and levels of professionalization required by various types of educational RDD&E programs.

6. The estimation of future supply and demand beyond the next year or two is extremely difficult. The overall scientific personnel requirement projection is based on very modest estimate rates of increase for R&D activity into the early 1980's, with apparently more than adequate graduate training capacities now established in nearly all R&D fields. With the possible exception of health and mental health, there is a general projection of oversupply of trained personnel. Information regarding the transfer of trained personnel from one scientific discipline to another, based on studies by the National Academy of Sciences and the National Science Foundation, suggests transfers of one to three percent a year. On the other hand, data on shifts from one subfield of specialization to the other are markedly more meager but suggest a markedly higher rate, especially for new subfields. Rate of personnel transfer, especially for subfields, is responsive to shifts in funding. Adjustment of graduate training programs is much slower. Information at hand suggests that educational RDD&E personnel are now recruited from a variety of disciplines but there is little definitive information regarding either the disciplines or previous work experience. The projected oversupply of scientific personnel suggests that efforts at long-term projection of supply, which are already technically difficult, will almost certainly be in error if they do not take into account the transfer situation. The regional survey of Hood and Banathy (1970) is at best suggestive in its findings that there is a substantially larger non-federally funded competition from business and industry for personnel with the same general skills required by the educational RDD&E sector. Hence, questions regarding supply in relation to demand must consider not only the competition among competing sectors and sub-sectors for trained personnel in general, but the implications for retraining and continuing education in support of various types of differentiated educational RDD&E programs.

7. The problems faced by educational agencies in recruitment and training of educational RDD&E personnel are suggested by Brickell's (1970, 1972 in preparation) study of the state educational agencies. Similar up-to-date information regarding the local educational agencies is badly needed. The problem of educational agencies regarding lack of available training which are suggested by Byers (1971), Fluery, Cappelluzzo & Wolf (1970), and York (1968) (as well as a number of studies reflecting on the low quality of some ESEA Title I and Title III projects), clearly suggest the danger of "program drift" which may be encountered by Office of Education's proposed "Renewal Thrust."

Recommendations

1. Given the above situation, it is recommended that the Research Training Branch of the Office of Education entertain a strategy involving the sponsoring of several surveys over a period of several years, with the initial survey focused on laying a modest but valid base regarding the current situation in only two priority areas. First priority should be given to "Core" educational RDD&E performers funded by the Office of Education's Cooperative Research Programs, as well as the RDD&E-related efforts in vocational education and special education. Because of their high relevance it is also suggested that if funding is sufficient the survey be extended to include the Office of Economic Opportunity and National Science Foundation contractors and grantees conducting RDD&E work which is focused directly on educational problems.

In view of the importance that has been attached to the "Renewal Thrust" of the Office of Education in attempting to bring the R&D capabilities of educational agencies to focus on priority educational problems, it is recommended that the first survey include a secondary priority, study of the current RDD&E personnel situation in local educational agencies. Finally, because of their possible strategic relevance for federal program planning, monitoring and evaluation, we recommend that a special field interview survey of federal monitors and the other federal professionals and paraprofessionals in educational RDD&E be undertaken as soon as possible.

Information on local educational agencies, when combined with the data developed by Brickell (1970, 1972 in preparation) on RDD&E in State Departments of Education should provide an adequate description of the situation in public educational agencies at the elementary and secondary levels.

It is recommended that other peripherally related RDD&E activities in the Office of Education, (e.g., ESEA Title III projects or the evaluation of ESEA Title I projects, as well as the education related R&D activities of other federal agencies) be left to later studies. Similarly it is recommended that later surveys include information on junior colleges, colleges and universities. Other populations which might be considered later are the related non-federally funded activities (funded by foundations, business, industry, etc.). In terms of their dollar volume these other areas are of substantially smaller importance, but they need to be surveyed at some time in order to acquire eventually a reasonably comprehensive picture. However, in view of the limited funds currently available, it seems unwise to compromise the opportunity to secure adequate data in priority areas in order to secure a more comprehensive, but probably less reliable, coverage.

2. The preliminary analysis accomplished in this design study suggests that any immediate direct attempt to survey the supply situation is probably uncalled for. In our opinion the AERA task force survey conducted

by Byers (1971) is sufficiently recent and complete to satisfy needs with regard to training programs directly related to Educational RDD&E. It seems more important now to get a clearer fix on personnel in terms of their educational backgrounds and experience, and then to consider the feasibility of subsequent sample surveys of departments and programs in the several disciplines which may contribute to the development of trained personnel. The lack of appropriate training for educational developers, disseminators, and evaluators is sufficently well documented at this time. Our need is for more specific data on the demand, and on the specific nature of needed skills, knowledges and sensitivities in order to motivate and direct development of training programs corresponding to needed training requirements.

3. Similarly, after several months of study, we have concluded that a direct attack on the projection of mid- and long-term demand is probably fruitless. The draft questionnaire does include one question to the employers with regard to the nature of their possible personnel needs if they were to receive a 25 percent increase in funding next year. However, our main hope for projection of demand rests on relating employer project profiles and employee activity profiles to other survey data, including especially the dollar support, staffing patterns, training needs, etc., to establish more definite information about requirements in relation to funding in specified areas. It is our belief that this kind of information, when coupled with proposed funding plans and with other information (e.g., that developed by the AERA Task Force on Training and the Oregon Studies) may considerably enhance the personnel projection method employed by Clark and Hopkins (1969). Moreover, we believe that a basis can be established to examine the consequences, in terms of the implications of RDD&E personnel and training, of alternative proposed USOE programs. In view of the general uncertainty regarding the direction of RDD&E funding, this approach appears to be far more reliable and useful than asking employers in the field to guess what their requirements might be.

Summary

The above recommendations, taken together, point toward a markedly more modest initial effort than the originally proposed biennial survey of supply and demand. We have recommended narrowing the initially surveyed populations in order to obtain with limited funds a more adequate base of information regarding two priority sub-populations, namely, the "core" of federally funded educational RDD&E programs and projects, and the RDD&E activities in large and middle-sized local educational agencies. We have concluded that the current supply situation has been sufficiently well defined for educational RDD&E by the AERA Task Force studies, and that it probably could not be well estimated for other RDD&E disciplinary areas until a clearer picture of the education and experience of currently employed personnel has been developed. When such a picture does emerge, it is suggested that the survey approach described by Byers (1971) be refined and extended to other departments and other training programs. Finally, in regard to long-range supply and demand, we have concluded that problems faced here are so great that they should not be directly attacked until more information has been obtained and more funds are foreseeable. On the other hand, we have designed a survey that will lay a foundation of information which will enable the Office of Education to make reasonably reliable estimates of personnel requirements and training needs into at least the near and possibly mid-range, future.

The findings of this initial survey, combined with other information, should provide guidance for subsequent surveys which (a) could resurvey the same population to establish trends, extend areas of inquiry, etc., and (b) could include additional populations which have been suggested above.

Chapter 4

DESIGN OF THE STUDY

This chapter consists of two sections: overall design and sample selection.

Overall Design

Statements of purpose and objectives, the problem, design considerations and initial analysis were presented in Chapter 2. Description of preliminary analysis and planning work which led to a set of recommendations for the initial survey were presented in Chapter 3. On the basis of information and recommendations contained in these two chapters, the following general and specific objectives are recommended.

General Objectives

1. To describe the current RDD&E personnel structure and composition of Office of Education and other federally funded (e.g. NSF, OEO, NIMH & OCD) grantee and contractor employers.
2. To describe the current personnel employment structure and composition of USOE and other federal funding agencies (e.g. NSF, OEO, NIMH, & OCD) with regard to program/project monitors and other federal employees (including statistics, planning, programming and evaluation) administering or directly supporting educational RDD&E programs and activities.
3. To describe the current RDD&E personnel employment structure and composition of local educational agency employers.
4. To estimate current skills and training requirements of these employers.
5. To provide pertinent demographic, educational background, work experience, skills inventory, and other personnel and training information on samples of employees for 1, 2 and 3 above.
6. To provide a data base for later studies of trends and changes.
7. To provide a convenient sampling base for follow-up studies which may be required for OE priority policy and program requirements.

Specific Objectives

The study will provide descriptive information on questions such as,

- How many people are presently (1972) employed in selected federally funded educational RDD&E activities in the United States?
- How many people are presently (1972) employed by federally funded contractors/grantees and local educational agencies who are primarily involved in RDD&E activities?

- In what types of RDD&E activities are they employed?
- At what professional levels are they employed?
- What annual salaries do they receive?
- What part of their time do they devote to RDD&E activity?
- What are the distributions of RDD&E employees according to age, sex, race, and region?
- In what types of institutions are they employed?
- On what types of projects do they work?
- What kinds of work do they perform?
- What kinds of skills, knowledges, sensitivities do they need?
- Which skills or special competencies are in short supply or hard to find?
- How have RDD&E personnel been prepared for the job?
- What is their formal educational background?
- What training have they received?
- What is their experience and employment history?
- How do employers and employees evaluate available training and educational resources?
- What kinds of competencies are judged most needed?
- What kinds of training content are judged most important?
- What kinds of training formats are preferred?
- How long have RDD&E personnel worked in the same job?
- What are employee's impressions of the value of their present work?
- What other RDD&E or educational training do they have?
- What skills do they most want to acquire?
- How do employers recruit trained talent?
- What on-the-job activities do employers sponsor to improve employee skills?
- How does RDD&E dollar volume relate to personnel requirements?
- What are current and short range future requirements for RDD&E personnel?

- What are employer's plans with respect to RDD&E activity and what are the perceived trained personnel implications?
- How do employers respond to hypothetical changes in RDD&E funding conditions?
- Who are the employers (with specified characteristics) who would constitute a sampling frame for a new study of specific RDD&E issues?

When this kind of information is integrated with other studies (e.g., AERA series, Oregon Studies) and with Office of Education and other federal program plans, there should be a more adequate basis for answers to questions such as these:

- What types of RDD&E training and recruitment activities are needed?
- For which professional levels should training and recruitment be developed?
- How do training and recruitment requirements vary by type of RDD&E activity, institution type, geographical region?
- What types of training programs (content, format) are recommended for different RDD&E activities and professional levels?
- Which are the current critical skill areas where trained personnel is reported in short supply?
- What is the relation of current RDD&E dollars to personnel activity?
- What might be the consequences of marked shifts in level or content of educational RDD&E funding?
- How valid are the RDD&E personnel projections now available (e.g. Clark and Hopkins, 1969)?
- How can the RDD&E personnel projection base and methodology be improved with the use of this data base?
- What implications does this information have for (a specified) proposed USOE or NIE activity in terms of probable trained-personnel availability?

If a similar survey is repeated on a biennial basis there are a number of additional questions which may be answered, such as:

- What are the major trends in the RDD&E personnel structure?
- What is the relation if any, between trends in RDD&E funding and the RDD&E personnel structure?
- Are requirements in critical skill areas being alleviated or aggravated?
- What new requirements are emerging?

- What is the effect of USOE research training efforts?
- What other (e.g., employer-sponsored personnel development) reresources are emerging?
- Are there significant changes in the sources of RDD&E recruitment?
- What effect does the structural oversupply of trained personnel in related disciplines seem to have on the educational RDD&E situation?
- What information can be supplied to graduate schools that will enable them to match program planning with established trends in educational RDD&E demand?
- Which aspects of the RDD&E demand picture seem to be fairly stable and which are less so?
- Can a dynamic model of the educational RDD&E personnel system be established?

Study Design

This proposed study is best viewed as a baseline sampling survey of employers and employees who are engaged to some significant degree in educational RDD&E activity. The design calls for survey of six populations:

1. Federally funded educational RDD&E contractors and grantees
2. Educational RDD&E program offices in USOE and other federal agencies (e.g. NSF, OEO, NIMH & OCD)
3. Local Educational Agencies employing at least one full-time research position
4. Employees of (1) above who are engaged in RDD&E work
5. Employees of (2) above who are engaged in RDD&E work.
6. Employees of (3) above who are engaged in RDD&E work

The study will be designed so that (a) it can be repeated on an annual or biennial basis to estimate changes and establish trends, (b) it can be enlarged in scope to include populations of employers and employees such as federally funded training or education-related behavioral science RDD&E or non-federally funded education or education-related RDD&E.

The study will be focused primarily on a mail survey but field interview and telephone survey options will be provided to (a) estimate possible effects on data attributable to incomplete coverage, (b) estimate the effects of errors arising from response and nonresponse, (c) illuminate the interpretation of data obtained, and (d) check on the validity of responses and data interpretations.

Sample Selection

The domain of educational RDD&E is not well defined. Gideonse (1969, p.1) provides a point of departure with his definition: " . . . educational research and development (and by extension dissemination and evaluation) includes those activities which are initiated within the findings and methodology of the social, behavioral, and information sciences or are based squarely on them, and which either are oriented or can be viewed as oriented toward the improvement of education or instruction."

Sponsors of educational RDD&E include the federal government, state and local educational agencies, private foundations, industry and business, colleges and universities, and professional and academic associations.

Gideonse (1969, p. 47) divides federal sponsorship into two principal categories. In the first are three agencies which have been charged with or have adopted educational RDD&E missions: the United States Office of Education (USOE), the Office of Econonmic Opportunity (OEO), and the National Science Foundation (NSF).

In the second sponsor category are a number of agencies whose programs are indirectly related to improvement of the educational system, such as: The National Institute of Mental Health, The National Institute of Child Health and Human Development, or the Department of Defense. Figures developed by Gideonse suggests that approximately $250 million was expended on educational RDD&E in fiscal year 1968, with a documented minimum base of $192.29 million. The Office of Education accounted for 53 percent of the documented base; NSF, 12 percent; OEO, 7 percent, NIMH, 6 percent; NICHD, 4 percent and all other sponsors (state agencies, higher education institutions and professional and academic associations) 7 percent. These figures suggest that OE, NSF and OEO, the three primary agencies, may have accounted for as much as 72 percent of the "documented expenditure" and for 55 percent of the total estimated expenditure.

Because of shifts in responsibilities for programs (e.g., Head Start and Follow Through) and in levels of funding, it is recommended that educational RDD&E programs in the following federal agencies be considered for inclusion in the federally funded educational RDD&E "core" performer population: United States Office of Education (USOE), National Science Foundation (NSF) Office of Economic Opportunity (OEO), National Institute of Mental Health (NIMH), and Office of Child Development (OCD). These agencies in 1972, may account for 80 percent of all federally funded activity and for perhaps half of all U.S. educational RDD&E activity.

This core may be extended, at a later date, to include (a) other federally sponsored work, (b) private foundations or (c) others, including business and private industry (estimated at less than 7 percent of the documented base but more than 20 percent of the total).[1]

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[1] A regional survey of RDD&E performers in the San Francisco Bay area suggests that if "educational RDD&E" is extended to include "training," and "social science" RDD&E, the volume of RDD&E activity may be nearly tripled (Hood and Banathy, 1969).

4.6

Although educational agencies do not appear as major RDD&E sponsors and may not be major performers,[2] they are of special interest to USOE educational renewal and practice improvement programs. It is therefore recommended that educational agencies be studied at two levels:

1. Federal agencies (USOE, NSF, OEO, NIMH, and OCD officies sponsoring educational RDD&E programs), and
2. Local educational agencies (LEA's).

Sufficient information concerning state educational agencies based on a recent survey now exists.[3]

A two-stage sampling plan is recommended for the federally funded and and LEA populations, with employers as primary units and a subsample of employees as secondary units. For federally funded programs it may be possible to secure lists of personnel from federal project offices (project proposal budgets) for the selected projects and submit these lists to employers for corrections, otherwise lists of employees will be requested from the federally funded and LEA employers. (See question #3 in the draft employer questionnaires, Volume II of this report.) This procedure has been employed successfully in a survey of R&D knowledge, interests and attitudes of local education agency personnel (Hood and Hayes, 1967). It has the advantage of providing efficient sampling of RDD&E employees when sampling frames are only available for employers.

The number of federal agencies and federal personnel is sufficiently small that it seems in this case feasible to compile a list of all personnel and sample directly from it.

The overall sampling procedure that is recommended for the federally funded projects is that of stratifying projects by a measure of size and then sampling at random without replacement within strata, and subsampling persons at random without replacement from the projects. Sampling with probability proportional to a measure of size of project was considered and is feasible, but has not been recommended because the available measure of size (annual federal funds) may be poor, and because the use of ratio estimates will recover much of the efficiency otherwise lost.

We recommend not using the organization or the very large contract/grant (as in the case of Laboratories or R&D Centers) as a sampling unit because these "activities" are usually so relatively large and complex in mission, objectives, and structure that they would unduly complicate meaningful analysis at a "project" level and overburden the reporting director. It is recommended that the survey contractor examine all contracts or grants receiving say over $250,000. on an annual basis in the current fiscal year to see if they can be meaningfully subdivided into smaller more homogeneous "programs," "components" or "projects" which would then each be listed in the sampling frame as a separate primary unit.[4] Annual budget justifications, funded proposals, and other project office documents as well as the federal monitoring officer can be consulted for guidance. If satisfactory subdivision cannot be accomplished, it is not necessary for the success of the sampling design. A possible difficulty caused by using the project rather than the organization as a sampling unit is that the same person may be in more than one project. Hence, a person may be eligible for selection and selected more than once for the sample. Consequently, the lists of those selected from the same organization should be compared and overlapping eliminated.

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[2] Clark and Hopkins (1969, p. 76) data for 1964 indicate that state agencies and local agencies may account for less than 13% of the 1964 sample of RDD&E personnel. The Hopkins (1971) update "projects" the 1974 professional population at: USOE, 156; State Department of Education, 457 and schools and school systems 270 persons out of a total projected population of 8,669.

[3] Brickell (1970, 1972).

Except for non-response and the possible use of weights to account for overlapping personnel, the design is intended to yield self-weighting estimates (see Appendix E). If non-response and weighting are not highly variable, it may be possible to use the data without weighting, at least for preliminary results. Stratifying by size makes it more reasonable to accept those responding as an approximation to the entire stratum. A response rate of at least 90 percent should be sought for projects and 70 percent for employees. Mail, telephone or even personal interviews (in the case of employers) may be required to achieve these rates. In any case, a sample study of non-respondents should be undertaken.[5]

For planning purposes, the sampling designer may wish to consult Hopkins (1971) as well as the information provided in Chapter 3 for population estimate background information. Some population estimates are as follows.

1. Number of federally funded educational RDD&E Projects

An important distinction must be made in this case. Is the population to be defined in terms of all projects funded in the current fiscal year or all active projects (which may be funded in the current or previous fiscal year)? If the latter, the approximate number may be 1,500; if the former, it may be closer to 1,100. The latest published data at this writing is found in the USOE NCERD Annual Report for Fiscal Year 1970 (NCERD, 1971 pp. 7,9). These data show, for the Cooperative Research Program Approximately 800 "activities;" 343 additional ongoing activities in FY 1970 had their latest support in FY 1969. The FY 1970 obligations were $79.37 millions which suggests slightly less then $100 thousand per activity. But this is deceptive, in fact, since each R&D Center and Educational Laboratory is treated as one activity. These 28 activities account for $39.9 millions or 44 percent of all obligations. The distribution of number of activities to dollars is highly skewed with approximately half of the activities under $30,000. This situation is understood when one looks at the Regional Research Program (NCERD, 1971, p. 25) and discovers that its 207 "small-projects" (activities) were funded with only $1,800 thousand dollars or approximately $8,700 per project. (Note even here that the 207 projects were awarded to only 152 institutions and agencies, hence overlapping personnel are possible even at this very low level of project funding.) This level of funding is in marked contrast to the 28 activities represented in the Laboratories and Centers Programs where the average funding level was $1.24 millions. Thus there is nearly a 150-fold difference between averages for these groups and well over a thousand-fold difference between the smallest and largest activity. This tremendous range in level of funding is the reason for our recommendations that the projects be stratified on the basis of annual funding as the measure of size and that if at all possible, all USOE activities above, say, $250 thousand annually, and certainly all of the Laboratory and R&D Center activities, be subdivided into a number of programs or projects.

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[4] If this is possible, thought must be given to how to include the Laboratory, Center, or very large Program (e.g., National Assessment) professional management and professional support organizations.

[5] Note that follow-up of employees will be possible only if some means for identification of the person is provided. If identification is left optional there will be problems and if the employee is not identified follow-up will be impossible.

Making allowances for a possible five "projects" per Laboratory or R&D Center suggests that one might have arrived at approximately 1,250 "projects" for USOE Cooperative Research and possibly 1,400 for all USOE research and related-activities in 1970. We have not attempted to estimate activities closely for NSF, OEO, NIMH or OCD, but we assume that they would have significantly fewer very small projects, and thus might add as many as 200 activities. Finally, we have assumed that the number of activities in 1972 would be somewhat smaller than in 1970, possibly 100 less, to arrive at our estimate of 1,500 "projects" active with current or previous fiscal year funding.

2. Number of federally funded professional and paraprofessional personnel

This population is more difficult to estimate. We have notedin Chapter 3 (p. 3.22) that NSF survey data for Laboratories and R&D Centers suggest that a figure of $40,000 to $42,000. per professional might work for these institutions where a very high proportion of professionals work full time. The survey contractor might look at small samples of funded project budget for different funding statistics to arrive at dollar per professsion estimates. Because of the much larger proportion of part-time staff on these smaller projects, the dollar figure could be considerably lower. Possibly a more convenient and reliable estimate of the professional population is to be found in Hopkins (1971). Although Hopkins takes pains to point out that his numbers are "imaginary" and that one should look at the magnitude of differences between 1964 and 1974 (p. 12) the numbers do at least provide some kind of base estimate. Hopkins' baseline update projection, which includes only 80% of the original 1964 USOE "research and training" base (p. 10) plus only the NSF curriculum improvement projects, yields a 1974 projection of 4,079 (pp 14-15). However, this projection is based on a probably very conservative 5% a year R&D inflation rate. Making allowances for bringing the "base" back to 100% but at an inflation rate closer to 7% suggests that his 1974 baseline projection could be adjusted to approximately 4,700.

Applying Hopkins' argument that most of these 1974 positions already exist (pp. 22-23), the figure for 1972 might be 4,500 professionals. Finally allowing for professionals supported by OEO, NIMH and OCD educational RDD&E programs, we roughly estimate the federally funded total at approximately 5,500 professionals. When we turn to the paraprofessionals we are in limbo. As noted in Chapter 3, the R&D Centers employ 58 graduate students per 100 scientists. Appendix C presents educational levels which place B.A. and less personnel at 40% of staff for federally supported activities. A wild guess might put the number of paraprofessionals somewhere between 2,500 and 3,500, which suggests a grand total for professionals and paraprofessions in this "core" federally funded population at between 8,000 and 9,000.

3. Number of federal agency personnel

This is at best a very small population. Hopkins (1971, p. 20) notes that "there continue to be no better data available than the 1966 data cited in the original study" and sets his USOE estimate at 156 professional positions. Making allowance for this 1966 figure and extending the estimate to include the other federal agencies suggests a figure closer to 240 positions. Adding paraprofessions might bring it to 400.

4. Number of local educational agencies and personnel

In this case we have very good figures of districts available from the National Center for Educational Statistics. But we turn to the NEA Salary Survey (NEA, 1971) because it actually lists central office research administrative positions for reporting public school systems with enrollments of 12,000 or more for 1970-1971. Out of a total number of 578 operating systems, 452 systems (78.2%) reported usable data. Only 137 (30.2%) of these reporting systems reported one or more research administrator positions, and of the 137, 85 systems reported one position and 52 reported more than one position. The total number of research administrator positions reported is 287. The number of positions is roughly correlated with size of enrollment. As shown in the 1968-1969 survey (NEA 1969):

Stratum	Enrollment	Number of Systems Reporting	Research Administrator Positions
1	100,000 or more	25	96
2	50,000-99,999	51	91
3	25,000-49,999	88	59
4	12,000-24,999	293	75
	TOTAL	457	321

We note that with approximately the same number of systems reporting usable data in the two surveys, there is a drop in the number of positions reported.

Although 287 positions seems a small number, we note that Hopkins (1971) uses an estimate of 270, but this number is based on 265 persons in school research bureaus in 1964. Making an ample allowance for paraprofessional assistance suggests that the LEA population for systems with enrollments of 12,000 or more may not exceed 500 FTE persons. The number of persons in the remaining 16,701 districts is obviously so small that we recommend the initial survey either be truncated at the 12,000 enrollment level, or that some kind of one-page screening questionnaire be used first to locate districts having sufficient RDD&E activity for the regular questionnaire. In fact, as noted above, even for districts in the 12,000-24,999 enrollment stratum the odds are much less than even they will prove to have a "research" position.

Sampling Fractions

For purposes of illustration, assume that a sample of at least 1,000 federally funded personnel is desired. Given our estimate of 8,000 to 9,000 in the population, the sampling fraction may be set at one-eighth. Employing the sampling procedure outlined in Appendix E and using 8 strata we arrive at the following plan.

Stratum	No. Projects Sampled	No. Persons Sampled	Funding Range in thousands*
8	All	1/8	Above $2,250 (3%)
7	1/2	1/4	1,500 - 2,250 (4%)
6	1/4	1/2	866 - 1,500 (4%)
5	1/8	All	500 - 865 (5%)
4	1/8	All	281 - 500 (6%)
3	1/8	All	131 - 280 (6%)
2	1/8	All	66 - 130 (12%)
1	1/8	All	0 - 65 (60%)

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*Approximate range based on FY 1970 data for annual funding. If very large activities were subdivided, the dollar ranges for the top 4 or 5 strata would all be proportionally lower. Percentages in brackets are estimated percent of the total population of "projects" in each stratum if large activities are subdivided.

Assuming that where possible, the complex activities in the upper strata are subdivided into several more homogeneous "projects", the estimated number of primary units would be between 200 and 250 if all active projects (funded in the current or previous fiscal year) are sampled. The reader who is unacquainted with this type of sampling design may be troubled by the repetition of sampling fractions for strata 1-5. The same fraction must be used (see Appendix E). The purpose of these additional strata is to reduce the funding range within each stratum on the assumption that a more homogeneous set of projects will be created and that smaller variances will result.

Originally we had assumed that the same sampling procedure as illustrated above could be used for LEA's, but given the above information concerning the distribution of research administrator positions in LEA's it does not seem feasible. One approach might be to use the NEA Salary Survey (Table 29) as the sampling frame and take a 100% sample by contacting all 137 of the districts reporting research administrators. As a precaution, a random sample of the 441 school systems reporting either no administrative position or failing to reply to the NEA survey should be "followed up" to gauge the possible bias.

The federal agencies pose a similar small sample problem, but here fortunately there are only five agencies and a few score centers, divisions, or branches, almost all within the greater D.C. area. Our recommendation would be to attempt to construct the complete list of professional and paraprofessional positions and then to randomly select (possibly on some stratified basis) approximately 50 persons for field or telephone interview. This would result in a 10 percent or larger sample of the estimated population.

Technical details regarding the sampling design, including discussion of sampling procedures and estimation of expected values and variances, are presented in Appendix E.

Subcontracts and Consultants

The design has made no explicit provision for "second tier" performers. The Oregon Studies may provide information in some of their case profiles regarding subcontracts and consultants. A subsample of projects could be drawn to investigate this area. In most cases USOE requires approval of subcontracts over $2,500 and there is a good chance that some kind of subcontractor sampling frame could be constructed from federal contract office information. The consultant population is a greater problem. Field and telephone interviews might at least probe for number, kind, and extent of the use projects make of consultants. And, of course, one could attempt to develop lists of consultants and sample them in the same way employees are sampled. Because of definitional problems, difficulty in providing lists or sensitivity regarding the request, this kind of study, if done at all, would be better handled through field interview contacts with a sample of project directors.

Instrument Design

Description of the development and pilot test of the mail questionnaires is detailed in Volume II. The content of the questionnaires is discussed in Chapter 7 of Volume I. Field interviews and telephone interviews are discussed in Chapter 5.

Interviews with federal employees during the development of the employee these methods is not without some inherent weakness, however, and such limitations will also be examined.

The Use of Mailed Survey Questionnaires

Advantages. The desirability of using mailed questionnaires instead of personal interviews has been described by Erdos (1970). He discusses some ten alleged advantages of the mailed survey. Of these, the more compelling ones are:

1. Mailed surveys are more amenable to wide distribution than other methods of data-gathering.
2. There is less bias in distribution because the mail gets through to everyone and over overcome any inherent bias an interviewer might have in avoiding certain institutions or areas.
3. There is less chance of a biased reply, i.e., a greater likelihood of a truthful reply because the respondent is not under an immediate pressure to reply.
4. emanates from a single source, and consequently there is no need for field supervision, as there might be with personal interviews.
5. incurred in merely reaching the respondent. For example, factors involved in reaching the same respondent via personal interview would be much greater and might include traveling expense, per diem, telephone scheduling, car rental, etc.
6. Under the best conditions, it is conceivable that a nationwide survey could be completed within two or three weeks and yield several thousand cases.

Use of the mailed survey to obtain information about educational RDD&E personnel would have the same advantages provided the questionnaire would be relatively brief, uncomplicated, and ask simple, discrete questions. It is quite evident that the mailed survey questionnaire would be an acceptable method for obtaining such discrete information as age, education, time on job, previous experience, what one is doing on the job right now, how one feels about his job, etc. It is also evident that personal interviews would not be required to obtain this level of information.

Another advantage of the mailed survey is that it could at reasonable cost, fill RBT's need for national estimates of the employed educational

field interview to collect baseline data (i.e., estimating with reasonable precision the mean number employed in this field, their mean level of education, mean salary levels, etc.) would require that sampling be conducted on a scale that would probably exceed funding levels now being contemplated by RTB.

The educational RDD&E population should be expected to be a highly literate population with an exceptional number of college-trained and advanced-degree personnel. This implies that they are highly conditioned to verbal materials and it is likely they have had more than average experience in responding to tests and questionnaires. There is a reasonable probability that they will answer a questionnaire properly once they have decided to do so.

Limitations. Depending upon the purposes for which they are used, survey questionnaires are not without their limitations. Some of these have also been described by Erdos (1970):

1. They are not very useful if the mailing list is biased, incomplete or unavailable altogether. Problems of the mailing list, therefore, may not be separated from the questionnaire even if the latter is well constructed.

2. They are not very useful if complicated questions or chains of questions must be asked in which there is a considerable number of contingencies among questions, i.e., the respondent must be led carefully through what constitutes a decision-action diagram in a questionnaire format.

3. If the information required is very confidential or if the respondent has no assurance of how his responses are to be treated, he may choose not to respond to the survey questionnaire.

4. If a questionnaire is too long, there is risk of a low return rate. This is especially true of the typical domestic survey. The chances of a low return may be partially overcome if the subject matter is one of intense interest to respondents and if the sponsoring organization is highly credible to them.

5. If the addressee is not the respondent, there is the risk that the questionnaire may never get to the right individual. This occurs frequently when one is forced to address an organization, and when there is no standard functionary who may be addressed directly in all organizations.

Although the use of survey questionnaires appears to be useful for obtaining educational RDD&E information, it is quite evident that these limitations may not be ignored. Use of the questionnaire survey by the RTB would necessitate a complete listing of current, Federally funded projects, reflecting their funding levels, principal investigators, locations, etc. Otherwise there would be danger of selecting a biased rather than a random representative sample. The need to avoid complicated questions and complicated question chains applies to the educational RDD&E survey as it does to other kinds of surveys. The adverse effects a lack of confidentiality or an excessively long questionnaire may also apply. However, as opposed to the typical domestic survey, the RDD&E questionnaire would issue from a highly credible source and would be sent to respondents with substantial interest in its results. Under such conditions, it is quite likely that statements of confidentiality would be accepted. However, this does not necessarily mean that one could risk an excessively long questionnaire since the field of education has been surfeited with questionnaires. Unless the RTB is prepared to have its contractor conduct several follow-ups with their associated costs, or risk a low return rate altogether, questionnaires should be kept relatively brief and other means should be sought for obtaining more extended or complex information.

The Use of Field (Personal) Interviews

As contrasted with the mailed survey, the field or personal interview is a highly expensive technique, mainly because of costs incurred in simply getting to the respondent in a nationwide survey. However, there are circumstances which demand its use.

Advantages. Compared with the use of other survey techniques, the interview has certain advantages:

1. The personal interview is especially effective where there is no assurance that a questionnaire will be answered by the person to whom it is directed. There is no guarantee, for example, that superintendents of school districts will answer even questionnaires that are personally addressed to them.

2. Personal interviews are valuable when one wishes to take advantage of the respondent's expertise or lengthy experience in a field by means of anecdotal and other unstructured material.

3. They are useful when study of the desired information indicates that a questionnaire would become too long or complicated. This is especially true where there are related questions in chains or bifurcations.

4. They are useful when there is a need to place people and incidents in the context of a previous event.

5. They enable the interviewer to accomplish a task that the respondent would not otherwise do, such as listing his reading sources, personal belongings, etc.

6. Personal interviews allow for an in-depth exploration of problems that otherwise may be described only briefly in open-ended responses to survey questionnaires.

7. They allow the interviewer, if he is trained to do so, to place responses to the interview schedule in context with the respondent environment and his associates.

8. In the event the survey builder is starting in a new domain, interviews provide an opportunity to quickly examine issues that should be addressed in the survey itself, or at least in its pretest form.

9. Interviews dispense with the problem of missing responses or uninterpretable responses, provided the interviewer complies faithfully with his interview schedule and records entries as they are received.

10. They allow the interviewer to gain impressions of the respondent that may be used later for purposes of counseling, therapy, job assignments, etc.

Limitations. The personal interview is not without its limitations or weaknesses. Some of these include the following:

1. Unless interviewers are trained in the use of interview schedules before entering the field, their non-standardized performance may affect the reliability of the interview results.

2. Even with trained interviewers, there is a need for continuing field supervision and maintaining quality control on interviews. The loss of interview information is far more costly than the rejection of an individual questionnaire.

3. Because the cost of an interview is high(compared with the cost of reaching a respondent with a questionnaire) the interview must justify itself by the information that it seeks or by the value placed upon the access it creates to the respondent's immediate environment.

4. The possibility of interviewer bias is always present, and may have its source in inexperience or even the appearance of an interviewer. Should interviews be utilized as a part of the RDD&E survey, bias may be less of a problem than in interviews of social attitudes, living habits, political views, etc., since the main search would be for information. This is not to discount the possibility of bias entirely, however, since an RDD&E employee's expressed need for training might be affected by the professional status of the interviewer. The establishment of rapport must be emphasized because an interviewer will be questioning project directors, unit supervisors, and employees at a given site.

5. Since interviews flourish on anecdotal material and open-ended questions, interviewee responses are not directly amenable to coding and key punching. The responses frequently require that they be typed, edited, aggregated, and classified before coding for data processing. For large interview sample, the process of manual data reduction can become time consuming and can incur substantial labor costs.

6. The number of interviews that can be conducted by a single interviewer in a week is rather small, especially if he is involved in a nationwide interview survey which requires considerable travel Under such conditions, ten interviews per week are frequently mentioned as a basis for planning. If travel is localized or kept to high-density urban centers it is possible to exceed this number. An interviewer could visit two universities or school districts in the same urban area and interview the project director or the unit supervisor and an employee at each site on the same day, although he might not be able to maintain this schedule throughout the week.

7. Another problem associated with the scheduling of interviews is that a change in the schedule of one interview will often affect affect the others. If scheduling changes should occur while the interviewer is in the field, he must re-schedule the remainder of his trip.

These problems intrude upon all interview projects and they may be anticipated in the RDD&E survey. Fortunately, there are research groups that have made a specialty of interviewing surveys and have access to highly trained interviewers.

These alleged advantages and functions of the personal interview would indicate that at least some interviews would be useful for purposes of the educational RDD&E personnel survey. It has already been suggested that survey questionnaires should be kept brief and the items discrete; inclusion of questions about all RDD&E activities (identified by previous investigation) would contribute to a prohibitive length. However, the interview could be used profitably as an additional method of data collection to gain in-depth information in these areas. Needs for training and the extent of participation in RDD&E activities can be determined more appropriately from the RDD&E employer and employees at the same site through the use of the personal interview. The interviews also would enable the interviewer to relate responses to the actual work effort of a project, and to obtain a more accurate impression of the credibility of an employee's response that he needed more training on a particular activity.

The Use of Telephone Interviews

Telephone interviews are used when there are reservations about the reliability or completeness of information from a mailed questionnaire, or a concern that the questionnaire will not be answered. The telephone interview may substitute for the field or personal interview when the information desired does not require a face-to-face situation. Even if there is a loss of information as compared with the personal interview, the loss may not be considered severe enough to justify the latter. Budget considerations may also enter into the decision to conduct telephone interviews since they are less expensive than field interviews.

Advantages. The telephone interview has the following advantages over other techniques:

1. For most people in our society, the telephone has become a common instrument of communication and can be used by a trained interviewer to establish rapport with respondents in a survey.

2. Telephone interviews are less costly than personal interviews (unless travel is highly confined), and yet they are a source of information too complex for a mailed survey.

3. The telephone interview enables the respondent to function comfortably from his own environment and at a time of his choosing.

4. Telephone interviews eliminate the possibility of bias due to the appearance of the interviewer.

5. In studies where the personal interview has been adopted as the primary mode of data collection, the telephone interview may be used in lieu of travel to remote places where the cost per interview may rise sharply.

6. The telephone interview may be used as a back-up to questionnaire surveys, either to obtain missing information or to complete the questionnaire for valued respondents who may not have completed the questionnaire.

7. Quality control and monitoring of telephone interviews are much easier administratively than is the field supervision of personal interviews.

8. Eliminating the problems of travel makes it possible to conduct more interviews without loss of time between them.

9. Reduction of the data from the telephone interview can begin immediately without waiting for the interview information to be mailed back from the field.

10. Ideas and changes in procedures can be exchanged quickly and easily among interviewers manning telephones at a central source.

Limitations. Despite these advantages, the telephone interview has certain limitations which restrict its use in surveys, especially of the kind desired for educational RDD&E personnel.

1. Telephone interviewing seems to be a special art, not necessarily possessed by competent interviewers who are accustomed to functioning in a face-to-face situation. It is often difficult to establish rapport with the respondent and to maintain his cooperation, especially if the interview is of extended length and if the interviewer is interested in probing further into the remarks of the respondent. For this reason, the telephone interview is not always effective in obtaining in-depth information.

2. The credibility or professional status of the interviewer is of critical importance in the conduct of a successful telephone interview. In the case of the RDD&E survey, it would be necessary to consider commissioning well known professional personnel in educational research and development for such purposes. However, the special art of telephone interviewing may not be correlated with excellence in educational R&D.

In the context of the proposed RDD&E survey, it seems best that telephone interviewing be relegated to a supplemental role, i.e., to follow-up on incompleted questionnaires, to encourage "recalcitrant" respondents to return completed questionnaires, and to reach people in relatively remote locations in lieu of a personal interview.

The Convening of Group Panels

This method of data collection would call for convening groups in different geographic areas for purposes of discussing topics germane to the supply, demand, and utilization of educational RDD&E personnel. Project directors of federally funded R&D projects would be assembled from several universities or private research organizations in the same urban area. The agenda for discussion would be mailed to them in advance and space would be reserved at a convenient central facility. Group panels could be composed only of project directors or of RDD&E employees or, as a variation, the two could be brought together into a single panel. There are, of course, other arrangements for composing group panels, such as seperate panels for directors of large and small research projects or separate panels for unit supervisors in school districts responsible for different aspects of educational RDD&E.

Some advantages of panels include the following:

1. They reduce the need for travel by personnel since panels will be convened at central points.
2. Panels bring together people with similar problems and the interactions they generate could result in rich information that might not surface as dynamically (if at all) in individual interviews.

Some limitations exist in the use of group panels, as in all group discussions:

1. Some individuals may not respond fully in group discussions, yet these same people may be more cooperative in personal interviews.
2. The discussion must be led by a competent group leader to avoid difficulties in following the agenda. Unless a long session is held, it may be difficult to cover the full array of questions that would be asked in personal interviews.
3. There are problems in recording, transcribing, and analyzing group discussions. It is difficult to introduce a semblance of measurement into the aggregated responses from several group panels, as one is able to do with individual interviews.
4. Although there are ways of making up panels, in practice it might be difficult to convene several panels that were so similar in their composition as to justify the combining of data from all of them.
5. Accurate estimation of population characteristics is difficult, if not impossible.

Because the initial survey will be concerned with deriving specific information about the RDD&E population, its characteristics, its specific involvement in educational activities, where it is located, etc., it does not appear necessary to employ group panels. This information can be collected more conveniently by other methods. However, there would be nothing to preclude the RTB from arranging for a small number of panels to convene with the recognition that they are not a source of data per se. These panels might effectively provide a diversity of information or recommend priorities if allowed to set their own agendas or if challenged to identify the "most critical problems in the utilization of educational

RDD&E personnel" and then to arrive at solutions to them.

Major Considerations in Choice of Alternatives

The decision as to which type of data-gathering technique should be selected by the RTB for the initial survey should be based upon four main considerations:

The need to establish a broad data base on RDD&E personnel. For planning to proceed in the recruitment, training, and effective utilization of educational RDD&E personnel, it is necessary that the RBT assemble rather quickly a data base encompassing such information as the demographic characteristics of personnel currently employed in this field, their previous work experience, their educational and training background, their current involvement in RDD&E activities, and their needs for training to make them more effective. There also is a need for the RTB to project the numbers of personnel that may be expected to enter the field in the immediate future should an increase in spending occur for educational R and D.

Differences among alternative methods and their applicability to RTB needs. In order to provide information for an examination of such differences, a review has already been made of the alternative techniques *a priori* to determining the ideal methods or mix of methods that should be adopted for the initial survey. Review has included an assessment of the advantages of utilizing different modes of data collection in general, and of their inherent limitations and weaknesses. The review also discussed the feasibility of adopting each technique.

Constraints of cost and time in obtaining the required information. The RTB does not have unlimited funds for the conduct of the first survey and, at the same time, it has relatively immediate needs for personnel information for its own program planning. The cost of obtaining information from a single respondent varies greatly among the different methods of data collection that have been discussed as does the time factor.

The reliability and sufficiency of information derived. The personnel information to be derived from the survey must be both reliable and of sufficient quantity and quality to enable tests to be made of significant trends in the RDD&E population with respect to the numbers employed, their training, and utilization.

Recommended Priorities in Choice of Methods

In view of the above considerations, three levels of priority are recommended for adoption in the first survey. Because there is a need to obtain rapid and extensive information on the RDD&E population, top priority must go to the mailed survey questionnaire. This method is best suited to surveying large numbers of RDD&E personnel in order to make national estimates of their total population. This method is preferable to other data collection techniques in view of the costs that would be associated with drawing a similar number of respondents from the general RDD&E population.

The questionnaire should be relatively brief in order to insure an adequate response rate and to avoid the expense of an extended follow-up. Thus the questionnaire should be restricted to the most critical questions posed by RTB. There will be little opportunity for open-ended questions, problem definition, exploration in depth, etc. (some of which may not, at any rate, be compatible with the questionnaire technique).

Second priority should go to field interviews as a supplement to the mailed questionnaire. The number of interviews should approximate 150; this approximation can be adjusted downwards since it is dependent upon available funds beyond those allocated to the main questionnaire survey. The number of interviews would also be dictated by any decision to limit the field interview to certain cross-sections of the RDD&E population. The field interviews would serve two general purposes: (a) to explore in depth problems with both employers and employees regarding personnel utilization, career opportunities, etc.; and (b) to verify tabulated information derived from mailed questionnaires from those cross-sections of the RDD&E population chosen for interviews. Ideally, if interviews are to be used for in-depth exploration, these interviews should be initiated only after the mailed survey results have been analyzed in order to determine profitable areas for in-depth examination or inconsistencies that could be resolved by field interviews. However, if time constraints do not allow for a waiting period in which mature data emerge from the analysis of questionnaire responses, it will be necessary to construct an interview schedule around salient problem areas that are not being sampled in the survey questionnaire.

Telephone interviews will be considered a third priority if funding is severely restricted after the mailed survey and all of its attendant costs of data processing, analysis, and interpretation of results have been accomodated. As indicated earlier, however, we find it difficult to develop an enthusiasm for telephone interviews in view of the sensitivities of the RDD&E population and the difficulties of establishing an appropriate rapport in this medium of communication. Telephone interviewing is avowedly less expensive than field interviewing; however, for the same level of funding our preferences would be for a small number of field interviews. Ways of economizing on the cost of interviews by confining them to high-density urban areas will be discussed in a later section of this chapter. If the "trade-off" between cost and the number of interviews becomes less than originally anticipated, telephone contacts will be restricted to obtaining missing entries on returned questionnaires, follow-ups on non-respondents, and scheduling of field interviews.

Conduct of the Mailed Survey

Sample Selection

Selection of the sample for the mailed survey will follow procedures outlined in Chapter 4, Design of the Study.

Procedures for Insuring Cooperation and a High Response Rate

Several procedures are recommended for gaining the cooperation of respondents, including advance notification, appeals in accompanying letters, brevity and confidentiality of the questionnaire itself, and ease of procedures for completion and return.

Type names and addresses on cover letter to questionnaire	Check against original listing on roster
Assemble outer envelope, cover letter, questionnaire, and return envelope for each individual; enter ID number on questionnaire; if employer questionnaire, also assemble list of employees; mail out questionnaires	Assure that name and address on cover letter, outer envelope, and ID number are in agreement before sealing envelope; also, that employee list is correct one for project if mailing employer questionnaire
Prepare File Card for each individual and stamp date of mailing and sequence of mailing	

Processing of returns from employers. Since the survey sample may easily be divided into sub-samples, it is recommended that the mailout be conducted in batches. Procedures such as the following should be established for handling and reviewing returns from project directors.

Procedures for Handling Returns	Quality Control Measures
Maintain daily and cumulative records of returns	Read each returned questionnaire and determine whether it is undeliverable, a refusal or blank, partly usable but requiring follow-up, or completely usable
Pull file cards for returned questionnaires and sort into piles of usable, undeliverable, etc.	Code each card for undeliverable, blank, partly usable, etc.
For each partly usable questionnaire, determine whether it may be made usable by editing or by contact with; take appropriate action	Verify that missing entries and corrections have been made before questionnaire is placed in usable stack; change file card from partly usable to usable stack and re-code
For all employer questionnaires found usable, take employee names that have been listed and generate employee sample rosters	Assign ID numbers to employee sample rosters to identify their project assignment and employer
Identify all usable employer questionnaires which indicate there are no employees and sort cards for these into a separate sub-set	Code file cards for projects without employers to indicate that project director will be mailed one employee questionnaire that is to be completed by him
Prepare usable questionnaires for editing and coding	
Examine undelivered questionnaires to determine whether they were addressed correctly and should be re-addressed differently	Compare address labels with addresses in orginal roster

Mail out re-addressed questionnaires

The mailing sequence requires that project directors be surveyed first, with the request that they identify the full- and part-time employees on their projects. With the cooperation of the USOE sponsor, the contractor will secure personnel listings from funded project proposals and program plans on file in USOE in order to generate separate listings for each project to be mailed with the employer questionnaire. The employer will be requested to up-date this list by additions or deletions to indicate the current project staff with professional and paraprofessional status. If a project has no employee personnel, it is recommended that the employee questionnaire be mailed to the project director with pages 1, 2, and 3 only of the Project Director questionnaire attached.* The same procedure would be followed for unit supervisors who, in effect, may be one-man work groups with only temporary needs for assistance from other personnel.

Provision of advanced notice to employees. As employer questionnaires are returned, employee listings should be taken from them, and advance notice should be given to the employees. Exclusive use of the telephone for advance notice is not recommended because of the large size of the employee sample. Since the initial survey (should serve as) a pilot test for future surveys to identify optimal procedures in reaching the educational RDD&E population, alternative advanced communication "treatments" could be tried with both employees and employers. We do not perceive that a tryout of those described earlier would hurt the outcomes of the survey even if no differences were found among them in their effects upon response rates for employees.

Initiation of employee mailout. Starting with an OMB approved employee questionnaire, the procedures to be followed for the employee forms parallel those described above for the employer questionnaire under the section Initial mailout to employers. It will be necessary to prepare master reproduction copies of the questionnaire and its accompanying letter. As in the case of the employer questionnaire, the letter addressed to employees should be signed by a ranking federal official in USOE. The letter itself may be prepared by the contractor.

Rosters of employees should be prepared and an ID number should be assigned to each name. A record should be made of the date of mailout and a number indicating the sequence in the mailout to the designated individual. A card file also should be established for the employees. Construction of the employee roster and the card file should commence as soon as employee forms have been returned and employee names drawn from the employer questionnaires. Card files should not contain employee ID numbers. These should be recorded only on the employee rosters which should be kept in locked cabinets and made available only to contractor personnel who have been cleared for the project. The ID number to be assigned to employees should be cross-referenced to the ID number that was assigned to the projects director's questionnaire. This cross referencing will enable later analyses to be run between employer and employee responses.

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*These pages contain Project identification, funding, and activity items that will be required for comparison to personnel in other projects, the remaining questions are not relevant or essential in this particular case.

Processing of returns from the employee questionnaire mailout. Returns from employees will be processed like the employer returns. Questionnaires should be sorted and coded as undeliverables, blanks, partly usable, etc. A check should be made on undelivered questionnaires to see if they were addressed correctly or if other addresses can be found for the same individuals. Questionnaires with incomplete responses may require respondent follow-up by telephone. If a substantial number of blanks or refusals should be received, then further study of them may be warranted. Telephone contact with a randomly selected sample of cases may prove revealing. As problems with returned questionnaires are resolved, the questionnaires should be moved to the "usable" category and their file cards should be recoded to reflect the change. Formal editing and coding should then be initiated on all usable questionnaires.

A daily record of employee returns should be maintained, including the number of returns for each day and a record of cumulative returns. Cumulative returns should be expressed in percentages of the total mailout and should be kept separately for undeliverables, blanks or refusals, partly usables and usables. If a follow-up is made on partly usable questionnaires in order to obtain missing information by telephone contact or other means, they should be added to the "usable" group and cumulative percentages for the latter should be changed to reflect these additions.

Initiation of first follow-up on employers. Within the first week after the initial mailout to employers a card should be sent to all recipients. This card should contain a simple message, e.g. thanking those who have responded and reminding others in case they have not already done so. A separate letter should be prepared for the first follow-up. This letter should reiterate the message of the letter accompanying the initial mailout; it should also contain a note of appreciation to the respondent in case he has already returned the questionnaire in the interim, and a reminder for those who have not yet returned questionnaires. If the initial returns should be bad (e.g., below 40%), it may be necessary to telephone employers and urge them to complete their questionnaires. Our best guess, however, is that the initial mailout will yield a 50-55% return and that the first follow-up will raise the return rate to at least 65%. Several follow-ups may be required to achieve a satisfactorily high employer return rate.

The respondent card file may be used as the basis for the first follow-up. All cards that have not been pulled in effect comprise the first follow-up mailing. Procedures of the initial mailout should be followed, with the sequence and date of mailout to each non-respondent recorded on his card. Maintenance of such records is necessary if a recapitulation is to be made in the final report of the return rate from the initial mailout and subsequent follow-up mailings, the dates of their occurence, time elapsed between first and second mailings, etc.

Initiation of first follow-up on employees. The preceding instructions for a follow-up mailout to employers also applies to employees. One exception is that the first follow-up may have to be done in two waves. The first wave will consist of employees whose names were taken from employer questionnaires. Meanwhile, a follow-up on non-respondent employers will be sent. Non-respondents in this second group of employees will be the target of the second part of the follow-up.

Estimated Size of Mailed Survey for Planning Purposes and Cost Estimates

Time schedules and cost estimates for conducting a mailed survey of federally funded projects only have been predicated on the following:

1. There are approximately 1500 federally funded educational RDD&E projects.

2. There are between 8,000 to 9,000 RDD&E employees.

3. A sample of approximately 200-300 projects would be drawn for the survey. The number of project directors to be surveyed would be the same.

4. A sample of approximately 1,000 employees would be drawn from projects selected for survey.

Explanation of Schedule for Mailed Survey to Federally Funded Projects

The mailed survey is estimated to require a 10-month work effort. The schedule of events shown in Table 5.1 has been planned as follows:

Within the first two weeks after contract award, the contractor will meet with USOE sponsors to review the required work, the schedule of events, and the interim information to be delivered to USOE.

Work on the contract will commence following the briefing with USOE. Two tasks could be begun almost simultaneously. First, the federally funded projects that comprise the survey must be identified. Since the contractor will be required to locate the projects and to compile lists of project directors and project personnel, it may be necessary to spend at least least five working days in Washington, D.C. to compile this information. The other task that should commence immediately is obtaining clearance for the questionnaires and reproducing the survey materials (questionnaires, cover letters, self-addressed return envelopes, etc.)

Mailout of the employer questionnaire can begin during the second month of the contracted period and be concluded by the end of the fourth month. The schedule is presently based on an initial mailout and two follow-up mailouts. Since a return of 90% is desired for project directors, special attention should be given to providing advance notice, explanation, and persistent follow-up to secure employer cooperation.

The mailout of the employee Questionnaire can begin as soon as employers return listings of their employees. It is not necessary, therefore, for the employee mailout to be delayed until all employer returns are in. Employee listings returned with the first wave of employer returns would provide the basis for the first mailout to employees, and the returns from each later follow-up on employers would form the basis for successive mailings to employees. It is anticipated that processing of returns from the employees would terminate by the middle of the fifth month.

Editing and coding of all questionnaires would commence with early returns and would be a continuing effort until all returns were in. Coding would be completed during the sixth month of the study period.

A labor-intensive effort will be required for processing of open-ended questions. Both questionnaires have several questions of this kind. This work would be conducted almost simultaneous by with coding and editing and would be concluded during the seventh month.

Data processing, including keypunching, establishing a computer file, cleaning operations, and the basic analyses would consume approximately four months. Data processing would not necessarily be a continuing effort for that period of time, but it is expected that the file would be maintained so that the basic tabulations could be made and so that later cross-tabulations and other special analyses could be requested.

Report writing could begin as early as the seventh month or earlier, if desired, on the introductory material dealing with the sampling design, method of conducting the survey, etc. Interpretive write-up would begin as soon as data are available.

USOE should receive a draft copy of the final report 60 days prior to termination of the 10-month period. A month has been allowed for USOE review although more may be required. The report would then be returned to the contractor for corrections and publication.

With a computer file established, it may be profitable to continue with special analyses that would yield information about the educational RDD&E population beyond the basic analysis. These special analyses might include testing of differences among sub-sets of the population on selected characteristics, determining relationships that were not discernible from the intial report, testing the effectiveness of alternative systems for making future projections of the RDD&E population, and so on. This exploratory effort should be expected to consume a minimum of six additional months and may require a year. No attempt has been made to schedule this work since much of it would depend upon findings in the basic analyses.

Explanation of Estimated Costs for the mailed Survey

Cost estimates are presented in table 5.2 .

The total salary estimate ($34,718) includes an averaged employees' benefit cost at 30% of base salaries.

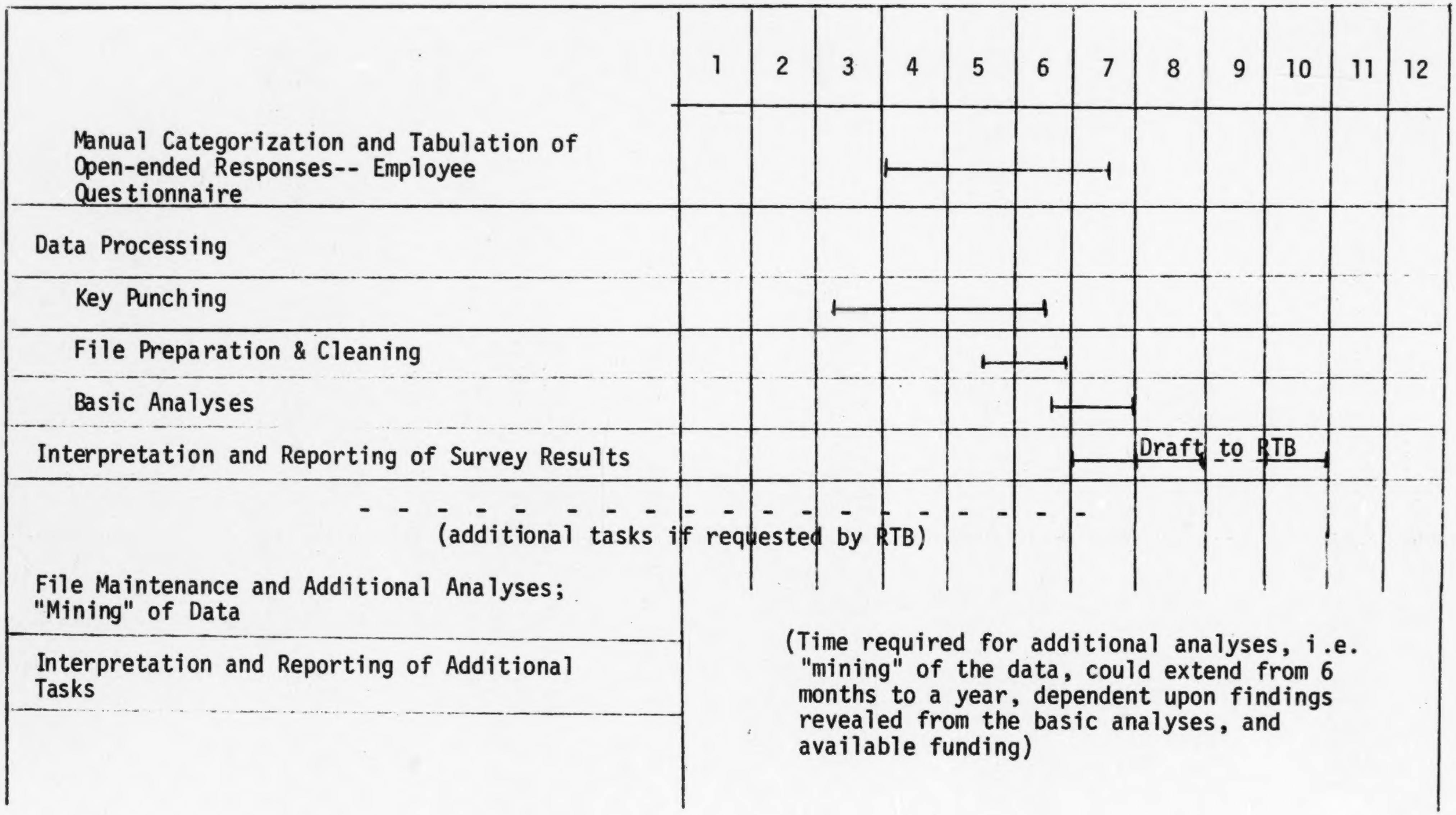
Data processing and computer costs have been estimated on the basis of obtaining mainly the basic analyses and cross tabulations. They may not

Table 5.1

Schedule for Conduct, Analysis, and Reporting of Mailed Survey to Federally Funded Projects

Tasks	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Briefing with RTB on Survey	—											
Sample Determination	—	—										
Questionnaire and Materials Reproduction	—	—										
Employer Questionnaire												
1st Mailout and Processing of Returns		—	—									
2nd Mailout and Processing of Returns		—	—									
3rd Mailout and Processing of Returns			—									
Employee Questionnaire												
1st Mailout and Processing of Returns		—	—									
2nd Mailout and Processing of Returns			—	—								
3rd Mailout and Processing of Returns				—	—							
Employer Questionnaire-- Editing and Coding		—	—	—								
Employee Questionnaire-- Editing and Coding			—	—	—	—						
Manual Categorization and Tabulation of Open-Ended Responses-- Employer Questionnaire			—	—	—							

Table 5.1 Continued



(Time required for additional analyses, i.e. "mining" of the data, could extend from 6 months to a year, dependent upon findings revealed from the basic analyses, and available funding)

Table 5.2

Estimated Costs for Conduct of Mailed Survey (Includes 1,000 Employees and 300 Employers)

Project Personnel

Principal Investigator	2 man-months @ $1,755	$ 3,510
Sr. Professional	6 man-months @ 1,375	8,250
Data Analysts or Assistants	6 man-months @ 687	4,122
Clerk/Typist	3 man-months @ 519	1,557
		$17,439

Computer-Data Processing Personnel

Project Supervisor	2 man-months @ $1,375	$ 2,750
Data Processor	5 man-months @ 992	4,960
Data Clerks	3 man-months @ 519	1,557
		$ 9,267
	Total Salaries	$26,706
	Benefits at 30% of Salaries	8,012
	Total Salaries and Benefits	$34,718

Additional Survey Costs

Reproduction of Questionnaire	$ 500
Postcards, Postage, and Mailing	740
Telephone Follow-up (for 150 calls at average cost of $10 for 30 minutes)	1,500
Key Punching	390
Computer Processing	3,000
Travel (Includes 4 trips for one person to Wash., D.C. from West Coast & per diem at $32 a day for 8 days; includes also one trip for two people for 5 days to derive project information. Airline travel estimated $350 per round trip)	2,700
Report Production	1,500
Total Additional Costs	$10,330

Total Costs without Overhead	$45,048
Overhead Estimated at 50% of Salaries (50% of $26,706)	13,353
Total Costs plus 50% Overhead	$58,401

cover all the analyses described in Chapter 7.

Additional costs have been estimated for reproduction of materials, mailing computer processing and writing of the final report. Travel has been planned from the most distant U.S. point (West Coast) to Washington, D.C. several trips have been planned for initial for interim visits. A stay of at least one working week for two people also has been planned so that information on project directors, project location, and project personnel may be identified from records USOE and other federal agencies.

Estimated costs for an extended analysis of survey data. Beyond the basic output of survey findings as described in the chapter on data analysis, computer files were generated that will allow for further statistical analyses analyses which should add to the accumulation of knowledge about the RDD&E population, its structure, and activities. These extended analyses would be concerned with such projects as determining the factor structure of RDD&E activities, developing more precisely the employee composition of projects according their RDD&E "mix" and their substantive content, as well as other analyses that would inevitably lead to refinements in the survey questionnaries and the introduction of new inquires for a second survey.

The following costs are estimated for the above purposes.

Software	$ 3,000
Computation	8,000
Salaries for Computer Supervision and Analysis	15,000
File Maintenance & Data Processing Assistant	10,000
Preparation of Monograph	20,000
Total	$56,000

The costs for extended analyses are, of course, negotiable. The RTB may request that the contractor submit an estimate of costs for a limited number of analyses which appear most promising.

The Conduct of Field Interviews as an Adjunct to the Mailed Survey

Several reasons were advanced in the preceding section for the development of brief questionnaires. As a result, the Employee questionnaire samples only 25 as compared to 94 RDD&E activities that were identified by the AERA Task Force. The need exists, to assemble more information on work and needs for training and also to determine correlaries between employers

Table 5.4

Estimated Costs for Conduct of 100 Interviews of Educational RDD&E Personnel Throughout the U.S.

Contractor Personnel Costs

Principal Investigator	2 man-months @ $1,755	$ 3,510
Sr. Professional	4 man-months @ 1,375	5,500
Data Assistants	6 man-months @ 687	4,122
Clerk/Typist	1 man-month @ 519	519
	Total Contractor Salaries	$13,651
	Benefits of 30% of Salaries	4,095
	Total Salaries and Benefits	$17,746

Interview Costs

Salaries for 5 Interviewers (Includes $100 for 3-day training session and $250, for conduct of 20 interviews, or $350 for 5 interviewers)		$ 1,750
	Total Salaries and Benefits	$19,496

Additional Costs

Estimates for Interviewer:

Air Travel	$ 550		
Car Rental	60	($20/day for 3 days)	
Gas	20		
Subsistence	18		
Per Diem	192	($32/day for 6 days)	
Mailing	10		
Telephone	200		
	$1,050	x 5 Interviewers	$ 5,250
Materials and Reproduction			200
		Total Additional Costs	$ 5,450

Total Costs without Overhead	$24,946
Overhead Estimated at 50% of Salaries (50% of $15,401)	7,701
Total Costs plus 50% Overhead	$32,647

1. Salaries have been costed for the contractor team that would develop and pretest the interview schedule, supervise the field effort, analyze interview results, and prepare a final report. This team would consist of the principal investigator for the entire survey, a senior professional primarily responsible for the interview phase, and two data assistants.

2. Interviews would be planned in ten major urban areas and five interviewers would conduct 20 interviews in his own immediate area and in the most contiguous urban areas in each region.

3. Interviewing contracts would be prepared for the following flat rates: $100 for the three-day training session, and $250 for the conduct of 20 interviews.

4. Planning would be based upon four interviews per day, or an approximate total of five days of interviewing. Two days would be spent in the local area of the interviewer, and the remaining three days would be spent in other areas that would necessitate air travel, per diem, and car rental.

Conduct of Interviews in Federal Agencies Associated with Educational RDD&E Program Planning and Project Monitoring

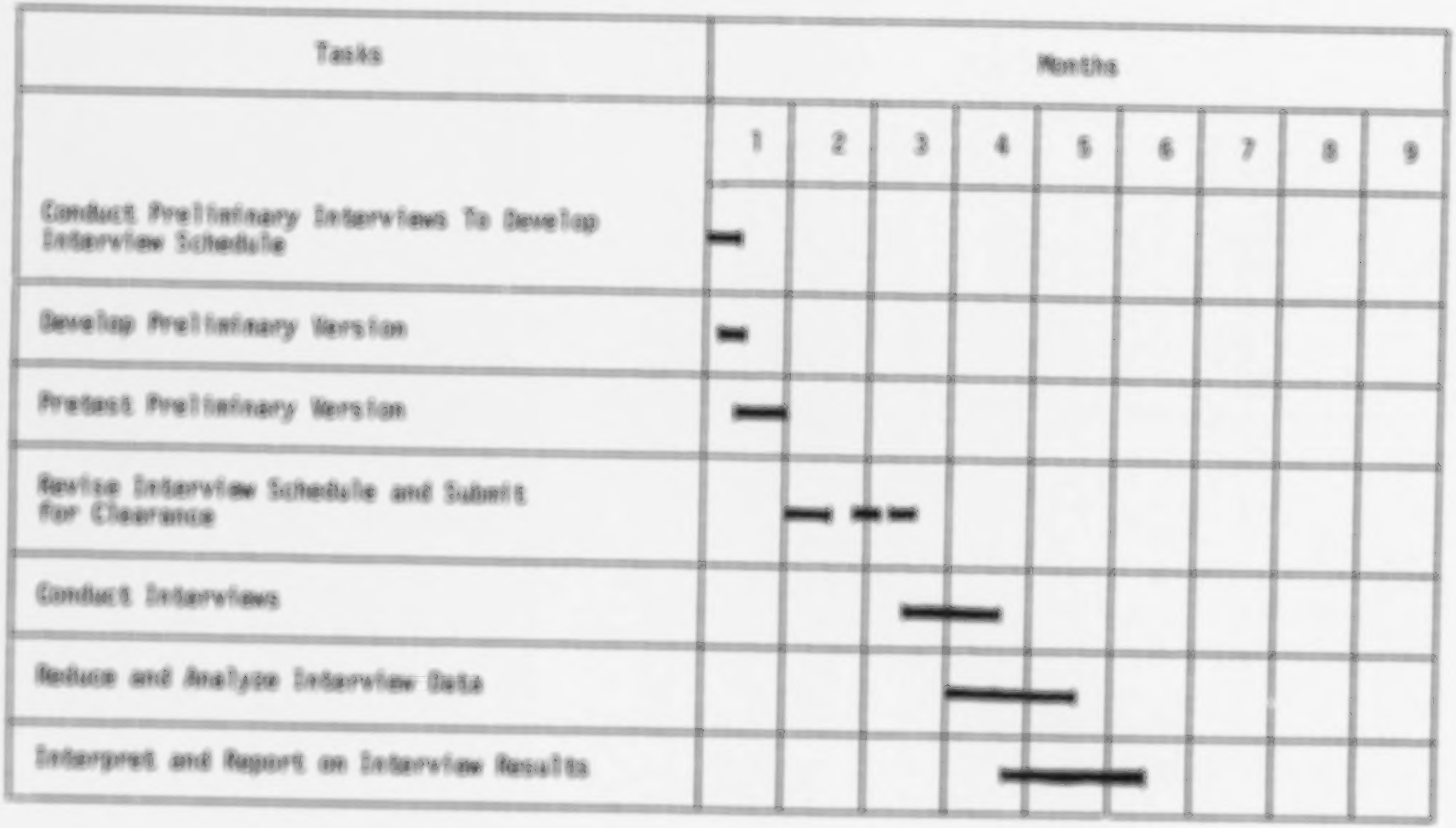
Approximately 400 professionals and paraprofessionals may be employed by the "core" federal agencies. In educational RDD&E, including program administration and planning, program evaluation, monitoring, and the analysis and compiling of educational statistics. This population is different in its composition, functions, and training needs from the staffs of federally funded projects, although many government professionals may have similar background and interests (Gideonse, Chapter VI). It is felt that a minimum of 50 interviews will be required to describe this population, how it is employed, its training needs, and its projected personnel needs. An interview guide will have to be tailored. No attempt will be made here to describe the questions that should be included since the guide should be developed on the basis of preliminary interviewing and pretested in the federal agencies. The agencies that will be contacted during the interviews include USOE, NSF, OEO, NIMH, and OCD. Further identification of appropriate organizational units within these federal agencies will be made in consultation with the USOE sponsor when the study is initiated.

Schedule for Conduct, Analysis, and Reporting of 50 Interviews

The schedule for the conduct of 50 interviews is shown in Table 5.5. Approximately 6 months is estimated for development through interviews and final reporting of the results. This estimate could conceivably be shortened if OMB clearance could be obtained in less than a month. Although interviews could be scheduled during this time, it would be preferable if clearance time could be reduced to two weeks.

Table 5.6

Schedule for Conduct, Analysis
and Reporting for 50 Interviews
in Washington, D.C. Area



Explanation of Cost Estimates in Federal Agencies

Cost estimates for obtaining 50 interviews from personnel in federal agencies associated with planning, programming, or monitoring of educational RDD&E are shown in Table 5.6. These costs include contractor support and the hiring of a qualified individual residing in the Washington, D.C. area to conduct the interviews.

Contractor support would be required for development of the interview guide, including some preliminary interviewing. The contractor also would integrate results of the interviews into final reports.

The individual to be hired in the Washington D.C. area would be recompensated at the rate of $50 per day for a period of seven weeks. It is estimated that 50 interviews and the scheduling required for them could easily be accomplished within five weeks. The remaining two weeks would be used for familiarization with the project, actual participation in the development and tryout of the preliminary version of the interview guide, and consolidation of the results after the interviews are completed.

The Conduct of Telephone Interviews

Telephone interviewing would provide a third way for contacting respondents. Although telephone interviewing is less expensive, preference would be given to field interviews. However, telephone interviewing appears to be a special technique that is not necessarily favored by those trained in field interviewing, and it is understood that problems do exist in using this medium.

On the other hand, if highly respected professionals in educational RDD&E can be recruited and trained, the method may be attractive. The contractor should consult Dr. Blaine Worthess, Boulder, Colorado, regarding the AERA Task Force experience.

An analysis was made of telephone costs assuming a West Coast contractor and calls to be made to all parts of the country using direct dialing on a station-to-station basis. Assuming a 15-minute scheduling calls for turndowns, re-scheduling, etc., the following cost estimates were determined (see Appendix 6 for supporting data):

For 60 telephone interviews plus extra calls	$1180.
For 120 telephone interviews plus extra calls	$4360.
For 240 telephone interviews plus extra calls	$8720.

These estimates are exclusive of personnel costs.

Telephone calls would be useful in support of the mailed survey to clarify response or to obtain missing information. They would also be

Table 5.6

Estimated Costs for Conduct of 50 Interviews in Federal Agencies in Washington, D. C.

Contractor Personnel Costs

Principal Investigator	1/2 man-month @ $1,756	$ 878
Sr. Professional	1 man-month @ 1,375	1,375
Clerk/Typist	1 man-month @ 519	519
	Total Contractor Salaries	$ 2,772
	Benefits of 30% of Salaries	832
	Total Salaries and Benefits	$ 3,604

Other Costs for Contractor

2 trips to Washington, D. C.	$350 per round trip	$ 700
6 days per diem	$32 per day	192
Telephone		200
Materials and Reproduction		200
		$ 1,292
	Total Contractor Costs	$ 4,896

Costs for Conduct of 50 Interviews

Interviewer Costs:

7 weeks or 35 man-days	$50 per day	$ 1,750
Subsistence and other expenses (parking, gas mileage, meals, taxi costs, etc.)	$20 per day for 35 man-days	700
Telephone		100
One trip to contractor-Air travel		350
3 days per diem	$32 per day	96
	Total Interview Costs	$ 2,996

Total Costs without Overhead	$ 7,892
Overhead Estimated at 50% of Salaries (50% of $4,552)	2,276
Total Costs for 50 Interviewers Including Contractor Support for Development and Monitoring	$10,168

useful as an adjunct to field interviews should the interview sample include projects that were so removed fromthe major urban areas that they would not justify travel costs.

Procedure for Telephone Interviews

A scheduling call would be followed by a mailout of materials if the project director consented to the interview. These materials would enable the project director to assemble information on project costs and staff in advance of the interview and provide a general outline for the discussion.

If the employee is to be selected from the same project, the director would be asked for employee names and an employee would be scheduled also for later interview. There may be some reservations among employees in responding frankly during an extended telephone interview since there may be a lack of privacy in the project environment. One option would be to call the employee at his home for the interview. The other option would be to schedule employers and employees from different projects entirely.

Scheduling of 100 Telephone Interviews, Including All Study Phases

Although we have stated preferences for field interviews, the RTB may wish instead to consider the use of the telephone interviews. These could either supplant the field interviews or provide for additional interviews.

In Table 5.7 a schedule is presented for the conduct of 100 telephone interviews including the tasks required from initial development of two interview schedules (Employer & Employee) to the analysis and reporting of results. Nine months are estimated for completion of this project. It is conceivable that at least one month could be saved with early success in development of pre-test versions, and if time were to be saved in OMB clearance and RTB review of an initial draft of the final report. If the results of the telephone survey were not to be perceived as a separate report, they would be incorporated into a final report embodying results from the mailed survey and other projects funded under the same contract.

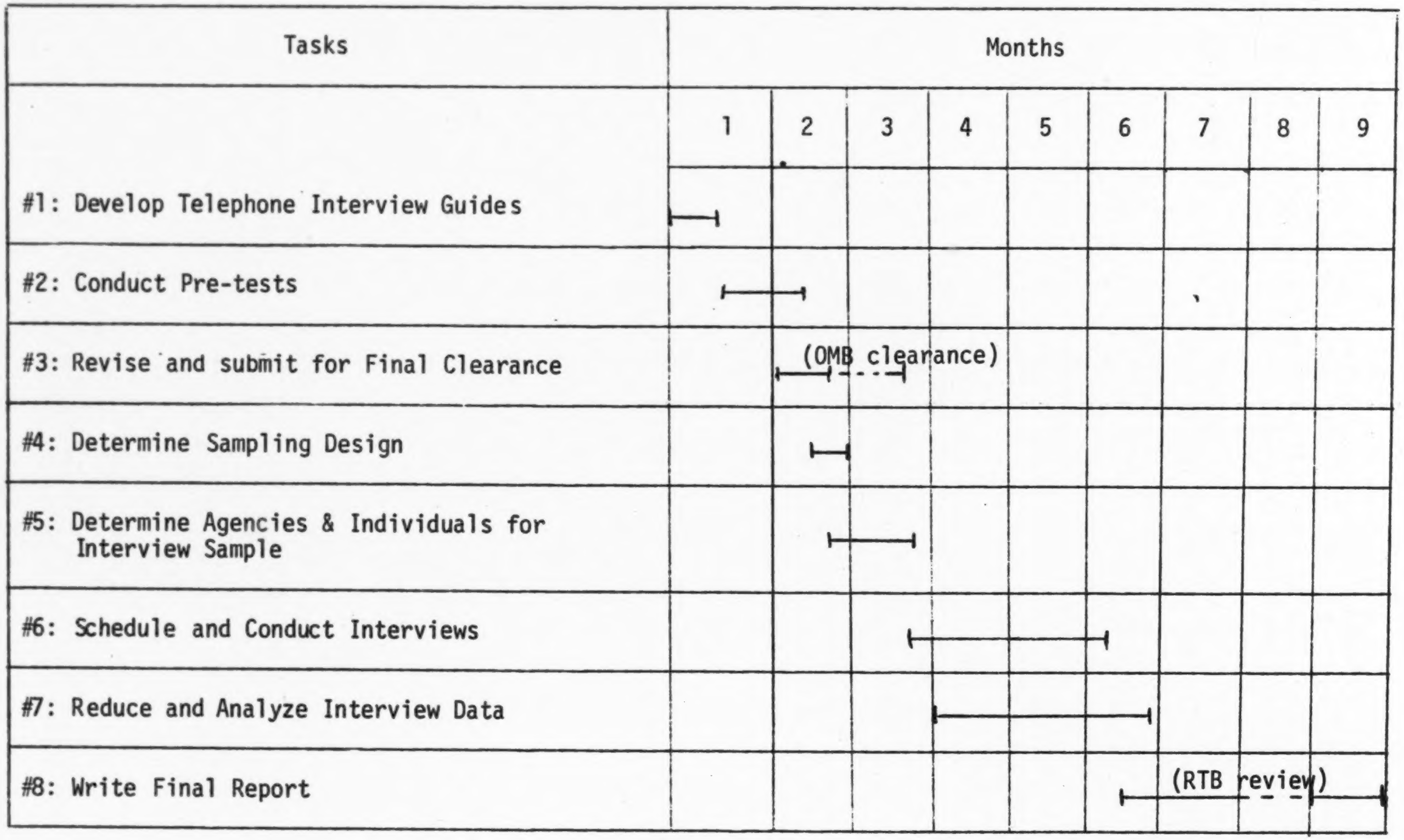
Scheduling and conduct of telephone interviews is planned on the fo following basis: two professionals would be responsible for both responsibilities. A senior professional would handle interviews of project directors and employers.

A week of scheduling 30 calls would be followed by a week of 25 interviews that would be consummated. Five weeks would be required for scheduling and interviewing respectively, with the number of calls estimated as follows:

No. of calls Desired	No. of 15-min. Scheduling Calls	No. of 60-min Telephone Interview Calls
40 Employees	60	50
60 Employees	90	75
100 Total	150	125

Table 5.7

Schedule for Conduct, Analysis and Reporting
for Telephone Interview Survey of RDD&E Personnel



Extra calls are included beyond the desired 100 interviews because of turndowns, call-backs, finding that there are no employees, finding that the project has terminated, etc. For 100 interviews, about 40 projects would be involved with a project direct and at least one employee from each project. In some cases the project might yield two employees. Another option is to round off at 50 projects and draw an equal number of employers and employees from each one.

Estimated costs for the conduct, analysis, and reporting of the telephone interviews are shown in Table 5.8.

Table 5.8

Estimated Costs for Conduct, Analysis, and Reporting of 100 Telephone Interviews

Personnel Costs

Principal Investigator	2 man-months @ $1,755	$ 3,510
Sr. Professional	4 man-months @ 1,375	5,500
Professional	1 man-month @ 991	991
Data Analysts	4 man-months @ 687	2,748
		$12,749

Total Salaries	$12,749
Benefits estimated at 30% of Salaries	3,825
Total Salaries and Benefits	$16,574

Additional Costs

Telephone Costs	
150 scheduling calls at average cost of $6.00 for 15 minutes	$ 900
125 interviewing calls at average cost of $20.00 for one hour	2,500
Total Telephone Costs------	$ 3,400
Mailing Costs	100
Materials and Reproduction	200
Total Additional Costs---------	$ 3,700

Total Costs without Overhead	$20,274
Overhead Estimated at 50% of Salaries (50% of $12,749)	6,375
Total Costs plus 50% Overhead	$26,649

6.4

Information Retrieval

The requirements for information retrieval may derive from:

- Agency capability searches in which lists of agencies specific capabilities or characteristics are required.

- Special purpose surveys in which the formatted Employer Data File will be used as a source for generation of samples.

- File subset generation for use in statistical analyses.

The first type of search may entail a more detailed specification of search criteria to focus on the specific objectives of the search. Search specifications must be expressible as variable length logical strings of conditions applying to defined data elements and must allow for combined tests so that many elements in a file may be tested concurrently. A second requirement is the capability of extracting desired data elements from selected records and recording these in fixed format on a tape or disk. Also desirable is a capacity for variable report format specification using the extracted data elements as input. Format of output reports may vary with search request and should be specifiable.

The second type of retrieval, special surveys, is basically similar in nature and requirement to the first, although specification of search variables will generally be less complex. This file subset may be required for analyses of the information already contained in the files and labels may be needed for mailing of the sample survey.

Retrieval for statistical purposes again involves record selection, although generally fewer criteria will be applied and much larger file subsets will be created. Data element extraction will be needed to format an abbreviated record containing only the elements needed in the analysis.

The retrieval flow is shown in Figure 6.3. Retrieval and formatting will be batched. File search will be sequential rather than random access. Interactive searches will not be justified due to cost. The software selected should have the following features:

- Parameters for control of retrieval and formatting should be input by punched cards.

- All data entries that meet specifications should be available for selection and extraction (note: security features may be desirable with respect to sensitive data elements).

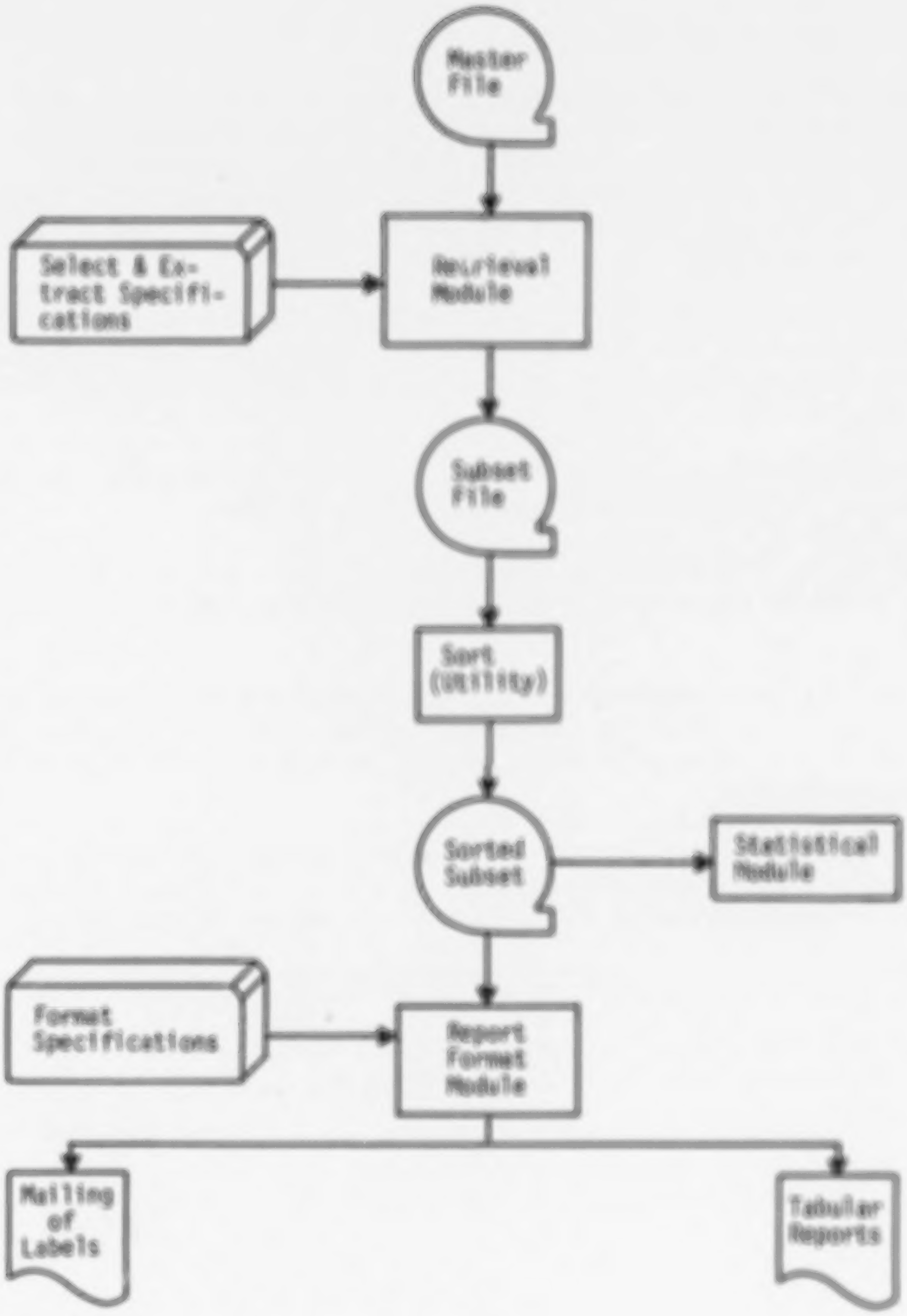
- Selection logic should include relational operators (equal, less than, greater than) and connectors (and, or, not).

- Specification of matching values in the selection criteria should allow for masking out part of the data item as irrelevant to the criteria.

- Searching of repeated groups should be possible.

Figure 6.3

Retrieval


Master File
Select & Extract Specifications
Retrieval Module
Subset File
Sort (Utility)
Sorted Subset
Statistical Module
Format Specifications
Report Format Module
Mailing of Labels
Tabular Reports

- Data should be extractable from the master file in one run and placeable in subfiles for further processing, analysis or report generation.

- There should be flexibility in specification of report and subfile formats.

Statistical Processing Capability

The program should provide flexibility to specify variables and formats. Generally the need will be for commonly encountered survey research processes such as counting, organizing, summarizing and tabulating. Most data items will be qualitative categories. Relatively few items will be quantitative (e.g. dollar volume, percent of effort spend on work activity).

Single variable frequency distributions will be needed with tabulation formatting for: frequency counts for specified class intervals, cumulative frequency distributions, percent distributions, or cumulative percent distributions.

Cross tabulation capability will be necessary to generate two-way and three-way crossbreaks with row and column totals.

Provision for counts of the number of observations, number of no-responses and the high and low values for quantitative variables should be required.

Provision for computation of the following statistics may be desirable: mean, median, mode, standard deviation, standard error, correlation, test of difference of two means, test of difference of two univariate or bivariate distributions.

The ability to format the resulting distributions or tables with appropriate titles, row and column headers and statistical labels is desirable. The statistical analysis flow is shown in Figure 6.4.

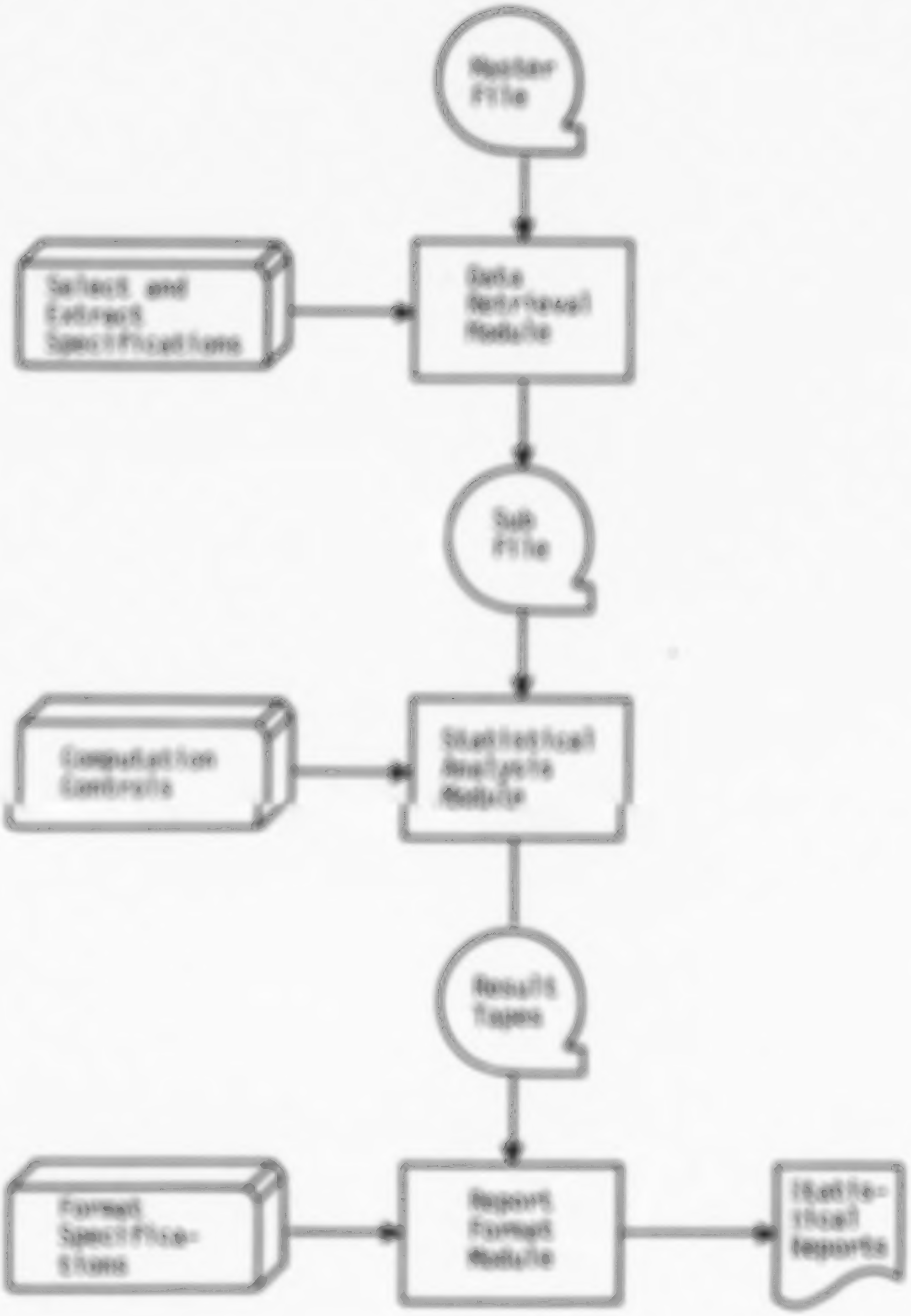
Estimated Cost of Maintenance of a Data Bank for Two Years

The following costs are estimated for maintenance of the data ban during the two-year interim between surveys.

Maintenance of files, tape back-ups, etc.	$ 1,000
Special requests for analyses	2,000
Part-time data processor/librarian	10,000
	$13,000

Figure 6.4

Statistical Analysis


Master File
Select and Extract Specifications
Data Retrieval Module
Sub File
Computation Controls
Statistical Analysis Module
Result Tapes
Format Specifica- tions
Report Format Module
Statis- tical Reports

Chapter 7

ANALYSIS, INTERPRETATION, AND REPORTING

Introduction

This chapter will examine the items contained in the employer and employee questionnaires and suggest analyses that could be undertaken. The discussion will be organized in the order that the survey report might follow.

Listing of Available Information

Before proceeding to a discussion of recommended analyses, it may be helpful to review the content of the questionnaires and the types of data that may be derived. The reader will find copies of the draft questionnaire in Volume II. A listing of the data follows.

Data Available for Analysis from the Employer Questionnaire [1]

The Employer Questionnaire contains 14 questions relating to personnel composition, recruitment, selection, attrition, and methods for training. It also requests information on each project with respect to its funding level and sources, major areas of work effort (reported in terms of 12 basic activities in education RDD&E), and major areas of concern with regard to the content of the investigation and project objectives.

Approximately 150 measures or items can be derived from the questionnaire. A description of the items is to be found in Table 7.1.

Data Available for Analysis from the Employee Questionnaire

The Employee Questionnaire consists of 16 questions relating to *demographic information* concerned with age, sex, race, etc.; *job information* regarding salary, length of time on job, supervisory responsibilities, job satisfaction and advancement possibilities; *previous education and work experience* with respect to its extent, type and relevance for current RDD&E job; *current involvements* on the job in 25 activities running the gamut of educational RDD&E; *training interest*, i.e., the desire to receive training in any of the 25 activities, and the importance of receiving college credit for training; and, finally, *training experience*, i.e., involvement in internships, supervised OJT, etc., and the value perceived by employees for various training approaches.

The list of variables is shown in Table 7.2.

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[1] The Contractor/Grantee and LEA employer forms of this questionnaire differ only in their cover pages and requests for funding and project information.

7.2

Table 7.1

Employer Questionnaire Data

Nr. of Items	Question or Page Nr	Variable Reference Nr	Data Type	Item Description Project Categorization and Filing
Var	p1	1	C	Types of RDD&E projects engaged in by school districts -- no. of responses made to each type
Var	p1	2	C	Major RDD&E functions performed in school districts -- no. of responses in each functional area
Var	p1	3	C	Project objectives as defined by project directors -- classifications to be determined
Var	p1	4	C	Projects defined according to their content area -- voc. education, teacher training, disadvantages, pre-school, etc.
10	p2	5-14	R	Type of organization in which project resides (school district, university, private R&D organization, etc.)
3	p2	15-17	R	Project funding levels (last fiscal year, current fiscal year and anticipated for next fiscal year)
9	p2	18-26	R	Sources of current fiscal year funding ($)
12	1	29-40	R	Allocation of project work effort to 12 major RDD&E activities (conducting basic scientific inquiry, testing and evaluating new programs, etc.)
1	1	41	C	Specified "other" activities
1		27	C	Annualized Finding Level (precoded)
1		28	C	Duration of Project(precoded in months)

1 Var indicates the number of items is variable depending on coding schemes developed by contractor

2 Data Types: C= Coded by survey contractor
R= Response marked by respondent on questionnaire
D= Derived in data processing from other responses

Table 7.1

Employer Questionnaire Data (cont.)

Nr. of Items	Question or Page Nr	Variable Reference Nr	Data Type	Item Description Project Categorization and Finding
				Staffing
1	2	42	D	No. reported as professionals (full time or part time)
3	2	43	R	No. of professionals - full time
		44	R	No. of professionals-part time
		45	R	No. of professionals -full time equivalents
1	2	46	D	No. of paraprofessionals(full time and part time)
3	2	47	R	No. of paraprofessionals - full time
		48	R	No. of paraprofessionals - part time
		49	R	No. of paraprofessionals - full time equivalents
1	2	50	D	No. of technical personnel(full time and part time)
3	2	51	R	No. of technical personnel-full time
		52	R	No. of technical personnel-part time
		53	R	No. of technical personnel - full time equivalents
1	2	54	D	No. of clerical personnel(full time and part time)
3	2	55	R	No. of clerical personnel - full time
		56	R	No. of clerical personnel - part time
		57	R	No. of clerical personnel - full time equivalents
4	4	58	R	No. of currently unfilled positions -- professional
		59	R	No. of currently unfilled positions -- paraprofessional
		60	R	No. of currently unfilled positions -- technical
		61	R	No. of currently unfilled positions -- clerical

Table 7.1

Employer Questionnaire Data (cont.)

Nr. of Items	Question or Page Nr	Variable Reference Nr	Data Type	Item Description Project Categorization and Finding
4	4	62	R	No. of personnel losses during last year -- professional
		63	R	No. of personnel losses during last year -- paraprofessional
		64	R	No. of personnel losses during last year -- technical
		65	R	No. of personnel losses during last year -- clerical
4	4	66	R	No. of personnel additions during last year -- professional
		67	R	No. of personnel additions during last year -- paraprofessional
		68	R	No. of personnel additions during last year --technical
		69	R	No. of personnel additions during last year -- clerical
4	5	70	R	No. to be hired in next two years--professional
		71	R	No. to be hired in next two years--paraprofessional
		72	R	No. to be hired in next two years--technical
		73	R	No. to be hired in next two years--clerical
4	6			If funding increased by 25% next year:
		74	R	No. of people to be added --professional
		75	R	No. of people to be added --paraprofessional
		76	R	No. of people to be added --technical
				No. of people to be added --clerical
				Derived Staffing Proportions
4	4 & 2			Proportion currently unfilled to filled positions
		78	D	Professional (VR #56 -- VR #40)
		79	D	Paraprofessional (VR #57--VR #44)
		80	D	Technical (VR #58--VR #48)
		81	D	Clerical (VR #59--VR #52)

Table 7.1

Employer Questionnaire Data (cont.)

Nr. of Items	Question or Page Nr	Variable Reference Nr	Data Type	Item Description Project Categorization and Finding
				Personnel Attrition Rate (Loss Rate)
4	4	82	D	Professional (VR #60 -- VR #40)
	&	83	D	Paraprofessional (VR #61 -- VR #44)
	2	84	D	Technical (VR #62 -- VR#48)
		85	D	Clerical (VR #63 -- VR #52)
				Personnel Addition Rate (Gain Rate)
4	4	86	D	Professional (VR #64 -- VR #40)
	&	87	D	Paraprofessional (VR #65 --VR #44)
	2	88	D	Technical (VR #66 -- VR #48)
		89	D	Clerical (VR #67 -- VR #52)
				Prospected Hires Rate (over 2 years)
4	5	90	D	Professional (VR #68 -- VR #40)
	&	91	D	Paraprofessional (VR #69 --VR #44)
	2	92	D	Technical (VR #70 -- VR #48)
		93	D	Clerical (VR #71 -- VR #52)
				Hypothetical Hires (25% Increase next year)
4	6	94	D	Professional (VR #72 -- VR #40)
	&	95	D	Paraprofessional (VR #73 --VR #44)
	2	96	D	Technical (VR #74 -- VR #48)
		97	D	Clerical (VR #75 -- VR #52)
1		98	D	Staff Proportions for Full Time Equivalents
4		99	D	Professional (VR #43 --VR #36)
		100	D	Paraprofessional (VR #47--VR #36)
		101	D	Technical (VR #51 --VR #36)
		102	D	Clerical (VR #55 --VR #36)
				Staffing Comments
1	4	103	R	Commented on Current Vacancies (Yes, No)
Var	4	104	C	Reasons for Current Vacancies (Coded)
1	4	105	R	Commented on Losses (Yes, No)
Var	4	106	C	Reasons for Losses (Coded)
1.	4	107	R	Commented on Additions (Yes, No)
Var	4	108	C	Reasons for Additions (Coded)
Var	6	109	C	Required Skills in 25% Funding Increase

Table 7.2

Employee Questionnaire Data (cont)

Nr of Items	Question or Page Nr	Variable Reference Nr	Data Type	Item Description
Var	3	102	C	Interest in additional training for "other" activities
3	4	103-105	R	Amount of training (none, very little, moderate, extensive) in OJT or internship, inservice courses or "other"
1	4	106	C	Other specified training
6	5	112	R	Value placed on six training approaches (little or no, some, great)
Var	5	113	C	Other specified training approaches (post coded)
Var	5	114	C	Comments on training approaches(post coded)
1	6	115	R	Importance of receiving college credit for training (5 point scale)
Var	6	116	C	Comments on reasons for importance of college credit (post coded)
Var		117	C	Project Identification Codes: Contract/Grant or LEA Funding level of project Size of school district Setting (R&D Center, Laboratory,etc) Project RDD&E profile type Geographic Region etc.

The recommended survey is in fact four semi-independent surveys that may be related to each other as suggested in Figure 7.1.

Figure 7.1

Four Educational RDD&E Populations

	Employers	Employees
Federally Funded Projects	1. Project Directors	2. Project Staff
Local Educational Agencies	3. LEA Unit Directors	4. LEA Unit Staff

Because the federally funded RDD&E project populations (1 & 2) are markedly different from the local educational agency RDD&E populations (3 & 4) in terms of (a) the method of sampling and statistical estimation, (b) their probable types of activities, personnel and training requirements, and (c) the special USOE audiences with different interests in the survey results, it is suggested that the analysis of the federally funded data be treated separately from, but compared to, the local educational agency data.

Outline of the Survey Report

The following is a suggested outline for the report, which the discussion in this chapter will follow.

Chapter 1 Highlights

Chapter 2 Federally Funded Educational RDD&E Contractors and Grantees

- A. Employer Characteristics
- B. Employee Characteristics
- C. Personnel Requirements
- D. Training Requirements
- E. Financial Information

Chapter 3 Local Educational Agency RDD&E

- A. Employer Characteristics

B. Employee Characteristics

C. Personnel Requirements

D. Training Requirements

E. Financial Information (if collected)

Chapter 4 Special Personnel Population

A. Equal Opportunity and Affirmative Action

B. Paraprofessionals

C. Part-time Staff

D. Regional Distribution

Chapter 5 Comparison to Other Available Data

A. The National Register

B. The APA Manpower Data System

C. The NEA Salary Survey

D. AERA and Oregon Studies

Appendices

A. Technical Notes

B. Supplementary Tables

C. Questionnaires

The discussion of analyses in the subsequent sections will follow the above outline.

Highlights (Chapter 1)

This should be a brief section which, in narrative and graphic form, summarizes the survey results. The survey purpose, methods, and limitations should be briefly described. Contractor/Grantee project numbers, dollar distribution, activity profiles, settings and geographic distribution may be covered. Project employee numbers, demographic variables (age, sex, race), educational and experience backgrounds, and job satisfaction may be covered. Similar data for LEA's would be presented. Personnel requirements may be summarized, possibly focusing on size and composition of staffs, vacancies and turnover rates, methods of recruitment, sources of recruitment, and hard to fill skills. Training requirements may be summarized in terms of the most frequent or critical needs of employers and employees, noting any unusual differences among settings or types of RD&D or E employers.

Federally Funded Educational RDD&E Contractors and Grantees (Chapter 2)

Employer Characteristics

This section should begin with a description of the survey method, if it is not discussed elsewhere. A brief description of the federally funded programs, presenting pertinent statistics on total numbers of dollars and projects, etc., should also appear.[2] General findings should be presented in both narrative and tabular form for:

- number and types of project
    - dollar size distribution
    - federal program
    - content or substance of RDD&E effort
    - activity profile
- institutional settings
- geographic distribution
- cross tabulations of the above.

Number and types of project. Since the project is the primary sampling unit, the number of projects, dollar distribution, project duration, source of federal program funds, and general type of project can be ascertained from federal project offices for both the population and the sample. The USOE Projects and Grants Information System (PGIS) may be used to organize and tabulate this type of information for most USOE projects at the time the sample is selected.

The extreme range in dollar size and variable length of project duration deserve special attention. In Chapter 4 it was recommended that project funding be connected to an annual basis to arrive at a "measure of size" that would accurately estimate the size of project staff. It was also recommended that project sampling be stratified on an "annualized" federal funding size basis. Consequently the sampling method itself creates a convenient stratification by annualized funding level. It may be instructive to examine reported current funding (Variable #16) against the annualized dollar level to detect and resolve discrepancies. For purposes of analysis, however, the reported current total funding level should be preferred over the annualized Federal funding level.[3]

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[2] Material for USOE can be found in publications such as Research for Progress in Education (1971). This publication or its successors should be reviewed for survey planning information as well as assistance in discussion and interpretation of survey results.

Substantive content. We have left content as a variable for survey contractor post coding (see response variables 1, 2, 3 & 4; and project title, abstract or other Federal project office information). Gideonse's treatment of the substance of R&D (1969, Chapter 6) provides a number of content dimensions that might be employed.

Project activity profile. Examination of AERA Task Force on Training and Oregon Studies information (see Chapter 3) lead to the conclusion that categorizing projects into the four conventional categories of RDD&E would obscure important differences regarding personnel and training characteristics. Consequently a major effort in questionnaire instrument development and pilot testing was devoted to the development of a more extensive list of activity descriptions. The twelve activities listed in Question #1 (Variables 29 through 40) are the result of several pilot test revisions. Items 1 through 9 (see Table Shell 1) cover the range of RDD&E functional areas from basic inquiry to training target audiences in the use of solutions and programs.[4] Items 10, 11, and 12 cope with important subsidiary activities. Initially, we attempted to get respondents to estimate the percentage of their effort devoted to each activity. Respondents complained that this suggested a precision many were unwilling to estimate, but they would

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[3] The most obvious problem occurs with the multiple-funded project where the Federal funds (which led to the selection of the project) represent only a portion of the total funds. Since pilot test experience confirmed that most project directors could not or would not attempt to associate activities or staff with funding sources, the relationship to be examined should be between total current funds and current staff and activity without regard to funding source. This procedure will not seriously affect the analysis or interpretation, but does "fuzz" the definition of "Federally funded educational RDD&E". An alternative would be to set some level, say 50%, and exclude projects where less than 50% of funding (see Variable 18-26) was reported as funded from the selected Federal sources (e.g., USOE, NSF, OEO). Probably a preferable course would be to treat the proportion of Federal funds (derived from variables 18-26) as a basis for analysis, looking for differences between projects "nearly totally" (80% or more), "primarily" (50% to 79%), and "partly" (less than 50%), funded by the selected Federal agencies. Study of USOE Cooperative Research project titles and abstracts in relation to dollar size and project duration (Current Projects Index, June 1970) strongly suggests that both of these variables may be markedly correlated with a number of survey variables. Scatter plots or correlations for continuous "dependent" variables and contingency tables or coefficients for discrete dependent variables could be used to search for significant and noteworthy relationships.

Table Shell 1

DEGREE OF INVOLVEMENT IN RDD&E ACTIVITIES
(Specify Sample Group or Subgroup, N=_)

No.	Activity Description	Number Responding	Degree of Project Involvement			
			Large	Moderate	Small	No Part
		#	%	%	%	%
1	Conducting basic scientific inquiry related to educational problems.					
2	Conducting applied research studies directly related to educational problems.					
3	Investigating and assessing educational needs and requirements.					
4	Gathering and providing information for program planning and design					
5	Developing new products or solutions for educational programs.					
6	Testing and evaluating innovative solutions and programs.					
7	Creating wide-spread awareness of tested solutions and programs.					
8	Demonstrating effectiveness of solutions and programs to target audiences.					
9	Training target audiences in the use of solutions and programs.					
10	Financial planning, and accounting for resources and expenditures.					
11	Preparing reports, documentation, etc.					
12	Training project/agency personnel to perform any RDD&E activity.					

Table Shell 1, Cont'd.

Nr.	Activity Description	Number Responding	Degree of Project Involvement			
			Large	Moderate	Small	No Part
		#	%	%	%	%
13	Other Activities					

[a] It may not be possible to treat responses to "other" activities tabularly. If not, any remarkable information should appear in associated text.

respond to gross characterizations such as "large," "moderate," "small" or "no" part of their effort. These responses may be coded as 3, 2, 1, and 0 respectively. This is clearly an ordinal scale, but not precisely an interval scale. (A calibration study might produce weights which would permit treatment of aggregate data as on an interval scale.)

The simplest treatment of aggregated activity data would be to report percentages checking this level of involvement in each activity by total group and for subgroups, e.g., by institutional setting, funding levels, and federal program type. It may also be illuminating to partition the data by creating activity "subgroups" based on those marking "L" (large part of project effort) for items 1 (basic scientific inquiry), 2 (applied research), 5 (developing new products or solutions), 6 (testing and evaluating), and 7 or 8 (creating awareness; demonstrating solutions and programs). Since these subgroups roughly correspond to the conventional RDD&E categories, comparisons of the modal responses to each of the 12 activities for these five subgroups would disclose gross differences among them.

Some type of correlational and factor analysis or cluster analysis of the project activity profile data is recommended, either by itself or in conjunction with analysis of other employer and employee variables. One outcome of such an analysis should be a useful set of empirically derived project activity "types" by which much of the RDD&E data for both employer and employee data may be analyzed and presented.

For illustrative purposes, assume the following types of projects were derived and occurred with sufficient frequency to warrant separate treatment:

Predominant Activity	Type
Hr 1	Basic Inquiry
Hr 2 (but not 5)	Applied Research
Hr 2 & 5 (but not 6)	Applied R&D
Hr 5 & 6 (but not 2)	Development
Hr 7, 8 or 9	Diffusion
Hr 3, 4 & 6	Program Planning and Evaluation
Hr 6 (but not 3, 4 or 5)	Evaluation
None of the above	"Other"

---

[8] This set of activities was derived primarily from Clark and Hopkins' (1969) list of Functional Emphases in the Process of R,D and D, but is not identical with their list.

An empirically based derivation of project activity types would be a major contribution. Analysis and interpretation of survey data (e.g. regarding funding level, staffing, personnel and training requirements) in terms of empirically derived types would markedly enhance the value of the report since nearly all discussions of RDD&E personnel and training requirements to date have been in terms of *a priori* categories.

An illustration of analysis by empirically derived activity types is illustrated in Table Shell 2 (employing the illustrative activity type labels listed above).

Table Shell 2

Numbers of Projects and Funding Levels
by RDD&E Activity Type

(Dollars in Thousands, Current Fiscal Year)

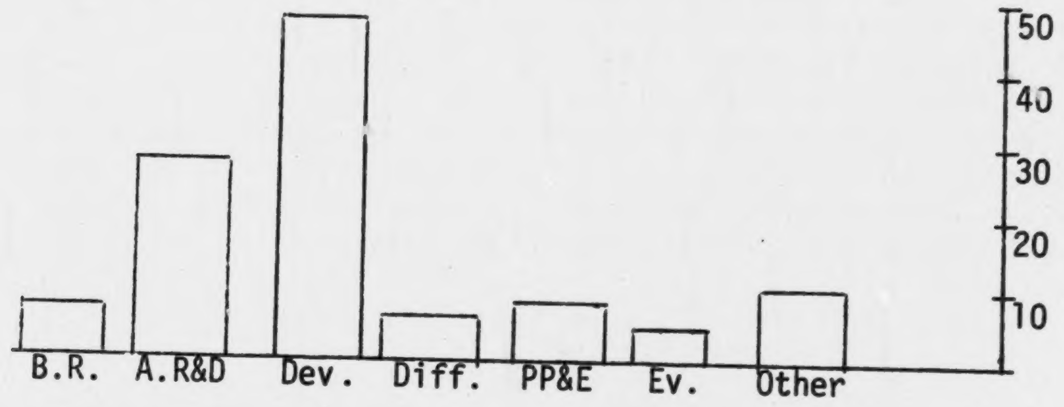
Activity Type	Projects		Funding Level		
	Nr.	Percent	Median	Interquartile Range	
Basic Inquiry	#	%	$	$	$
Applied R&D					
Development					
Diffusion					
Prog. Planning & Evaluation					
Other					
All Projects	#	100%	$	$	$

Note-- Probable skew distributions of funding suggest that median and quartile or decile range statistics may be less misleading than means and standard deviations.

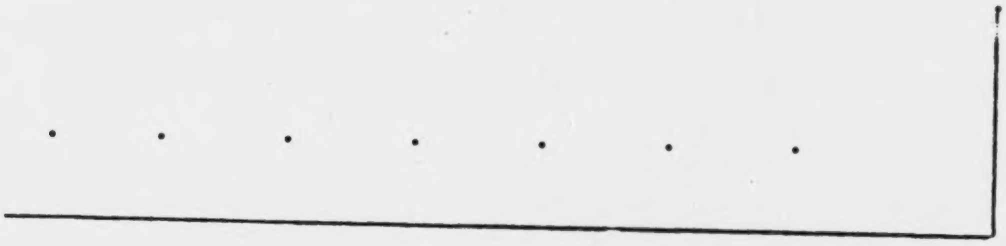
Figure 7.2

Percentage of Funds Received by Projects
(Classified by most prominent RDD&E functional type)
to All Funds Received by Agencies in each of nine Institutional Settings.

R&D Centers



Educational Laboratories



Federally Funded Project Employee Characteristics

Projected numbers of personnel. Details regarding staffing will be discussed in the section on Personnel Requirements, but estimated numbers of professionals and paraprofessionals should be given here together with an estimate of their confidence limits.

Demographic variables. Distributions for age, sex and race should be presented, possibly with age and sex cross tabulated. Age, sex and race should each be cross tabulated against institutional setting, RDD&E type, and USOE region. These tables should be placed in the appendix, and any notable differences discussed in this section.

Educational background. There are four items in this category: (a) highest level, (b) major for highest degree, (c) number of 21 listed courses taken, and (d) three course areas considered most important for current work. Educational level should be cross tabulated with institutional setting, RDD&E type, age, sex, and race. The first two of these cross tabulations may be of sufficient importance to place in the text, the remainder possibly in the appendix with narrative comment.

The major of highest degree should be coded and displayed separately for doctoral, master's and bachelor's degrees. This information might be best presented in both tabular (see Table Shell 5) and graphic form. The data in Table Shell 5 presents estimated numbers and percentages for major fields by total of all fields for each degree. This data is of some importance in establishing the numbers and proportions of personnel recruited into educational RDD&E by disciplinary background. Tables presenting percentages for major field by institutional setting and RDD&E types but possibly limited to doctoral and master's degrees with sexes combined should also be prepared and presented in the appendix. These latter tables should be inspected for patterns of recruitment from the various disciplines for different institutional settings and types of RDD&E. Notable findings should be discussed in this section of the text.

Table Shell 5

Major Area of Highest Degree
Estimated Number in Population and Percent in Sample
Degree Level by Major Field and by Sex

Degree Level	Doctorate		Master's		Bachelors		Other		Total Nr.[a]		Grand Total
Major Field	M	W	M	W	M	W	M	W	M	W	
Education	#(%)							#(%)	#(%)	#(%)	# %
Psychology	#(%)							#(%)	#(%)	#(%)	# %
etc.											
Other	#(%)							#(%)	#(%)	#(%)	# %
	100%							100%	100%		100%
Total Nr. Degrees [a]	#	#	#	#	#	#	#	#	#	#	#

[a] Projected to population.

Display of tabulations and cross tabulations for the twenty one courses listed in employee question number 2 might best be relegated to the appendix and only briefly discussed in the text. Certainly these course items should be cross tabulated by degree level and then examined in terms of differences by employer, institutional setting, and RDD&E type. Remarkable differences should be noted in the text.

The three areas considered most important for current work (last part of question #2) will be considered in the section on Training Requirements.

Work experience. Possibly even more important to the RDD&E employer than educational background is the amount and kind of previous work experience an employee may have. (Employee question No. 1). Because of the possible differences in types of activity and recruitment methods, it is suggested that experience be cross tabulated against both institutional setting and RDD&E project activity types. A possible tabular display is suggested by Table Shell 6. Similar tabulations for each major employer setting (e.g. Laboratories, R&D Centers) might be displayed in the appendix and summarized in the text as suggested by Table Shell 7.

Table Shell 6

Number of Years of Previous Employment,
Distribution, and Average Number of Years of Total,
and by Type of Previous Employer.

(N =)

Years of Previous Work	Type of Previous Employer						Total Previous Employment
	Coll. or Univ.	Ed. RDD&E Organiz.	Gov't.	Business Industry	School Dist.	Other	
1 - 2	#						#
3 - 4	#						
5 - 6	#						
7 - 8	#						
9 -10	#						
11-15	#						
16-20	#						
over 20	#						
Total Nr.	#						
Average	Mn.						

7.24

Data presented in Table Shells 6 and 7 provides some idea of previous employment and suggests possible recruitment patterns. (Conspicuously missing, thorug an oversight, is a direct question regarding where the employee worked before he joined his present employer. This information should be obtained.)

Table Shell 7

Percent of All Employees Reporting,
Number Reporting Previous Employment,
and Average Number of Years of Employment,
by Previous Employment Type
for Each Type of Current Employer

Type of Current Employer		Type of Previous Employer						Total
		College or Univ.	Ed. RDD&E Organiz.	Gov't.	Business Industry	School Dist.	Other	
Laboratories	Percent	%						(100%)
	Number	#						(Total Nr.)
	Avg. Yrs.	#. #						(Total Avg.)
R&D Centers	Percent							
	Number							
	Avg. Yrs.							
Colleges & Universities								
Non-profit								
etc.								

The information just given lays the groundwork for the question of work relevance. This information probably makes sense only with regard to either (a) type of institutional setting or (b) RDD&E activity "type". A possible display by institutional setting is suggested by Table Shell 8. Again, this type of Table may be better left in the Appendix and only described in the text in terms of its more salient findings.

The above sections summarize major findings concerning the number and types of personnel found in various RDD&E projects in terms of their age, sex, race, educational level and background and in terms of their previous work experience and its perceived relevance to their current job. In the next section the patterns of work activities will be examined in relation to both employer and employee characteristics.

Personnel activity profile. As in the case of the employer project activity profile, the 25 items contained in the Employee Questionnaire question number 3, have emerged from several revisions of pilot versions. The instrument is due to Hemphill (1960), but the items have drawn from both the Oregon studies and the AERA Task Force on Training studies. Earlier pilot test versions employed several alternate forms and over three times as many items. The present list is a compromise, hopefully short enough to not overburden the respondent but long enough to reveal something about the detail of RDD&E activity.

If properly analyzed for the pattern of items in relation to other data (most especially Project Activity Profile items and their derived project "types", funding level, content of projects, institutional setting, level of professionalization, level of education, degree major, etc.) a wealth of information can be created regarding the amount and kinds of RDD&E activities one finds being performed by what kinds and levels of RDD&E personnel.

At the simplest level of analysis, the 25 listed activities can be displayed in terms of the percentage of personnel rating each of the eight levels of involvement as suggested in Table Shell 9. A simpler, but less informative display would be to express the average ratings in a bar chart.

The 25 activity items should be correlated with each other and with other data (e.g., 12 Project Activity measures, project funding level, institutional setting, level of education, degree major, age, sex, level of professionalization, number of persons supervised, etc.) and then factor analyzed to develop a factorial interpretation of the correlates of RDD&E activity. The results of such an analysis should suggest useful displays of activity clusters with crossbreaks agains differentiating variables.

Certainly one should look for professional vs. paraprofessional, educational degree, sex, institutional setting and Project Activity Profile type differences. Much of the detail of such analysis will belong in the appendix with only major findings described and supported by simplified tabular or graphic presentation in the text.

Table Shell 8

Level of Relevance of Previous Employment Type for Present Job as Perceived by Employees in Different Institutional Settings

Previous Employer	Relevance of Previous to Current	Lab(s)	R & D Centers	College & University	Non-Profit	Business & Industry	Public Schools	SEA's	Professional Association	Federal Agencies	Other	All Settings
College or University	Low	%										%
	Medium	%	=100%									%
	High	%										%
	(Nr.)	#										#
Education RDD&E Organization	Low											
	Medium											
	High											
	(Nr.)											
Government	Low											
	Medium											
	High											
	(Nr.)											
Business & Industry	Low											
	Medium											
	High											
	(Nr.)											
School District	Low											
	Medium											
	High											
	(Nr.)											
Other	Low											
	Medium											
	High											
	(Nr.)											
All	Low											
	Medium											
	High											
	(Nr.)											

Table Shell 9

Average Rating and Percentage of RDD&E Personnel Rating Levels of Involvement in Each of 25 Activities

			Level of Involvement							
Activity	Nr. Rating	Average Rating	None 0	Minor 1	2	3	Substantial 4	5	6	Most Significant 7
1. Synthesizing literature	#	#.#	%							%
2. Choosing variables	#	#.#	%							%
....										
....										
....										
25. Using techniques of measurement										

Job information. Details of RDD&E activity presented in the previous section lay the foundation ofr the final section on employee characteristics dealing with job descriptions. In this section information should be presented on:

1. Number of years in present job with appropriate distributions for all personnel and by institutional setting, Project "type," and funding level. Correlates with age, sex, level of education, etc. should be examined and any remarkable ones noted.

2. Number of persons supervised, presented for total group and above crossbreaks, but also examined in terms of age, sex, level of education, time on present job, total years of work experience, and job activities.

3. Qualitative information regarding job titles, positions or descriptions of job may be examined for any remarkable information.

4. Ratings and comments by employees regarding their satisfaction with their present jobs (Question #7).

5. Ratings and comments by employees regarding advancement possibilities in their present jobs.

Items 4 (job satisfaction) and 5 (advancement possibilities) above should be examined together since they are probably related. Both should also be examined in terms of most employer and employee variables, including salary information.

Personnel Requirements

The two previous major sections on employer and employee characteristics will have laid the foundation for a more detailed examination in this and the next section of RDD&E personnel and training requirements. This section is organized in terms of four topics:

1. Staffing patterns
2. Vacancy and turnover
3. Recruitment and selection practices
4. Anticipated hires.

Staffing patterns. This topic may be introduced with an examination of the total numbers and proportions among professional, paraprofessional, technician and clerical personnel that are hired by projects within different institutional settings, with different RDD&E project activity profile "types" at different funding levels, etc. Most of the data can be presented in terms of average numbers, ranges and percentages.

Numbers of full time, part time and full time equivalents (FTE's) should be presented and examined in terms of possible differences similar to those above.

All of the above data comes from the Employer Questionnaire. The Employee Questionnaire data can be partitioned by professional vs. paraprofessional and time worked (both obtained from the Employer Questionnaire roster of professionals and paraprofessionals). This generates a four-fold relationship as suggested below:

Full Time Professional	Part Time Professional
Full Time Paraprofessional	Part Time Paraprofessional

Each group should be examined for possibly significant differences in employees characteristics (e.g., sex, age, educational level, time on job, employee RDD&E activity involvement). This information was treated in detail in the Analysis Report, Chapter 5.

Vacancies and turnover. Information regarding this section is obtained from the Employer Questionnaire (variables 58 through 69) and the derived proportions (variables 78 through 89).

It should be noted that the level of detail represented in these questions does not permit estimation of "RDD&E field" losses (due to death, retirement, leaving the RDD&E field, etc.) Such information is needed, and it is suggested that it be obtained on a smaller scale through either field or telephone interview where sufficient rapport with the employer may be established to acquire reliable information of this kind. The information obtained from the employer deals with turnover from his project level perspective and is intended to provide a perspective for recruitment, selection and training issues discussed later.

The numbers and proportions of unfilled positions, losses, and additions should be examined against available employer variables (especially funding level, project content, project RDD&E activity type, institutional type, and region). Employers' comments on current vacancies (variable 104), losses (variable 106), and additions (variable 108) should be treated in this section.

Recruitment and selection practices. Discussion of recruitment and selection can possibly best be introduced against the previous background of information on personnel staffing and turnover. The information for this section is contained in Employer Questions 9 through 13, and possibly 14.

The simplest datum is the percent reporting that they have done any recruiting in the last year (variable 124). For those answering yes, the employer is asked to describe (a) any skills or sensitivities that have been particularly difficult to find in recruiting, and (b) any difficulties in recruiting personnel with qualifications in specific content areas such as early childhood education, minority education, remedial reading, vocational education. For both (a) and (b) there is provision for a "Yes" or "No" response as well as write in space. The number and percent answering Yes to each item should be reported as well as the general content analysis of the write-in responses. This information should be examined agains major employer vairables (especially size, institutional setting and region). It seems especially important to compare hard to recruit skills and sensitivities against project RDD&E activity types and hard to recruit content areas against project substantive content.

The next aspect of this topic is concerned with recruiting procedures. Question #12 lists seven procedures (advertising, professional meeting employment services, etc.) and asks if the procedure has been used and if it has, the employer's appraisal of its effectiveness. This information might be effectively summarized also in the questionnaire format (see Table Shell 10).

Differences in recruitment methods should be examined for type of institutional setting, RDD&E Activity type, funding level, and possibly by region. "Other" recruitment methods which are frequently mentioned or considered very effective should be noted.

Selection technique. A similar question is asked regarding selection t techniques. The recommended analysis is the same. This question also requests comment on special problems in using selection techniques (variable 155). The content analysis of these comments should be discussed with pertinent details presented in the appendix.

Table Shell 10

Recruiting Procedures
(# Employers Reporting Have Recruited in the Last Year)

	Number of Employers	Percent of Employers	EFFECTIVENESS (Percent rating)		
PROCEDURES	Have Used	[a]Have Used	Minimally Effective	Moderately Effective	Very Effective
A. Journal or newspaper advertizing	#	[a]%	%	% 100 %	%
B. Professional meeting employment service					
. . . .					
G. Recruitment from within					
H. Other					

[a] number of employers reporting have used the method divided by total number of employers who have done any recruiting in the past year.

Anticipated hires. This final Personnel Requirement topic is examined in terms of employers' responses to questions number 5 and 6.

Question 5 asks for the number of employees the employer anticipates hiring in the next two years for each of the four personnel categories: professional, paraprofessional, technical, clerical. Question 6 asks for the number of employees that would be hired in the same four categories "if your funding were to be increased by 25% in the next year." It also asks what kinds of skills the additional staff would represent (e.g., proposal writing, statistical analysis, etc.) These two questions are a rough attempt at trying to establish an "employer based projection" for personnel requirements. (A funding based projection method will be described in a later section). Question five is a variant of the usual question, which assumes that the employer knows enough about the near future to accurately estimate at least gross numbers of new hires. Technically this question is inadequate in itself. A more detailed question would get at reasons for additions (e.g. replacement or increase). Hence analysis of this question needs to be made in relation to the employers turnover data. Certainly numbers of persons to be hired (variables 70-73) and rates of projected hiring (variables 90-93) should be examined against numbers and rates for current vacancies, losses and additions, all of which are on one year bases.[5] In retrospect question 5 should probably ask for estimates of the next year (or the next year and next two years) in order to place the current year turnover data on a comparable time base. As it stands numbers for the current year must be doubled or the numbers for the two year estimates must be halved to make direct comparisons for number of personnel or rate.

Question 6 attempts to place the "subjective" estimate for each project's future on a standard hypothetical base of 25% increased funding. The interest in this question lies more in what employers may say they would do about relative numbers of professionals, paraprofessionals, technicians and clericals and in what special skills they would look for. The things to compare here are changes in proportions of personnel categories between current staff and added staff and especially the skills the employer seeks.

Training Requirements

Although concern with training is the primary motivation for this survey, we have placed this section this far back in the body of the analysis report so that an ample background of conditioning variables could be examined first. The section consists of two primary subsections (a) employers' requirements and (b) employees' requirements.

Employers' training requirements. The employer is asked only two questions: (Question #7) what kinds of in-house training have you used during the past year? and (Question #8) How much value do you place on the following (eight) training approaches for current employees? Question 14, which asks for general comment on any aspect of RDD&E employment or training that is of interest or concern, may also contain information. (The requirements for specific types of training were left to the Employee Questionnaire in the belief that the responses would be more interpretable in this context because of the detailed information on the job, previous training and experience, etc.)

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[5] If there are a substantial number of less than one year projects in the sample, these projects may have to be treated separately.

Table Shell 11 suggests a summary treatment of question #7. The data for question #8 (ratings by employers of the value of eight training approaches) might best be presented in a tabular form similar to the actual questionnaire format, reporting number responding and percentage marking "little," "moderate" or "great" value ofr each format. Examination of differences in ratings of value by institutional setting, RDD&E type, and size of funding may be appropriate.

Table Shell 11

Percent of Employers Reporting They have Used
Various Kinds of In-house Employee Training During
the Past Year by Institutional Setting (N = ______)

	All settings	Laboratories	R&D Centers	. . .		Other settings
A. Special supervised OJT or internship	%	%	%			%
B. One or two week short courses						
C. One to five day seminars or institutes						
D. Longer courses						
E. "Other"						
Total Number of Employers by settings	#	#	#			#

If there are any comments by employers relevant to training (Question 14) they might be summarized here.

Employee Training Requirements. The first employee question relevant to training is suggested in question #2 which asks the employee to circle three (of 21) formal course work areas which he considers most important for his current work, "whether or not you have had course work in those areas." The frequency counts for these 21 course areas should be presented in several cross tabulations, probably separately by professional status or degree level compared to RDD&E Project Activity Type, project substantive content, and institutional setting. It may also be instructive to look at important formal course work as related to the 25 RDD&E activities.

Table Shell 12

Level of Current Activity and Interest in
Additional Training for 25 RDD&E Activities
(N = ___ Employees)

Activity	Rated Activity Level[a]	Interest in Additional Training		
		Great	Small	No
1. Synthesizing literature relevant to a project	#.#	%	%	%
			100%	
2. Choosing variables for research or experimental treatment.				
. . . .				
. . . .				
25. Using techniques of measurement to derive data for establishment of standards.				

[a] 8-pts (0 = not a part of my work, 1 = only a minor part of my work, 4 = a substantial part of my work, 7 = a most significant part of my work.)

Question 3 deals with both current involvement and interest in additional training in 25 RDD&E activities. This information can be summarized in Table Shell 11. Table 12 might be generated for major institutional settings, project substantive types, project RDD&E types and region; and for important employee characteristics (e.g. level of education, sex, professional status, etc.).

These analyses probably would belong in the appendix with only the important findings presented in the text. Some of this information might be summarized in terms of the first 5 or 10 rank ordered areas of highest interest for:

A. All personnel
B. Personnel by institutional type
C. Personnel by RDD&E project type
D. Personnel by project funding level
E. Personnel by region
F. Personnel by level of professionalization
G. Personnel by level of education
H. Personnel by salary level

Question 4 asks: "Since you have been employed in this field, how much of the following kinds of training relevant to ..[RDD&E].. have you had (none, very little, moderate, extensive) for (a) special supervised on-the-job training or internship, (b) inservice courses and (c) other (specify)* This question was asked to determine what was the extent of inservice training for different types of personnel. Responses should be examined by level of professionalization, level of education, sex, and type of project. The next employee training question asks for value placed on each of six approaches or formats for training. The question is relevant to the design and presentation of training.

The results can be presented in essentially the same form as the questionnaire (see Table Shell 13.)

Table Shell 13

Valued Approaches to Training
(__#__ employees)

Training Approach	Total Nr. Checking	Percent Checking		
		Little or No Value	Some Value	Great Value
A. Programmed instruction materials for your own use	#	%	%	%
B. Three to five day institutes	#	%	%	%
F. Extension Courses	#	%	%	%

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*The employer form, question #7 lists 5 options for in-house training used during the past year. Option (a) above corresponds to employer option A. Option (b) above includes employer options B,C & D. Hence a cross check on employer and employee information is available.

Responses to the "other" approaches (employee variable 113) and "comments" on training approaches (variable 114) should be treated here. Cross tabulations of approach ratings by major personnel variables should be run. Probably especially important would be to establish whether there are differences in preferred approaches in terms of the employees' interest in the 25 RDD&E activities (employee variables 77-101). Professional status (employee variable 12), level of education (employee variable 33), institutional type (employee variables 5-14), and region (employer variable 159) are other dimensions which should be analyzed since each is relevant to delivery of training in preferred formats.

Employee question number 6 asks for a rating and comment on the importance attached to receiving college credit for any additional training. This item, like the previous one, is of practical importance regarding how training is designed for delivery. It should be examined in terms of the same variables.

Because of its great importance to the sponsors of the survey, the final part of this section should summarize the major findings in terms of their implications for training needs by number and types of persons and numbers and types of projects in which they are located.

Financial Information

Project funding and salaries are of much morethan casual interest to this survey since they form a basis for attempting to project future personnel and training needs. Salary information will be discussed first, then funding, and finally, the problem of fiscal projection will be treated.

Salaries. Educational RDD&E is labor intensive, consequently much of the educational RDD&E project cost is related to salaries, either directly or indirectly (e.g., personnel benefits, overhead, institutional allowances). Moreover, behavioral science RDD&E is competitive. The ability to attract and retrain employees either as a specific employer or a class of employers is in part related to salaries relative to other employers. Finally, there are salary comparisons that can be made for a number of dimensions such as age, sex, race, length of time on the job, number of years of previous employment (and number of years of employment by type of institutions, and perceived relevance by employee), professional status, number of persons employed, full or part-time status, type of institutional setting, substantive content of project, project activity "type," etc. Most of these salary comparisons should be explored with relevant tables placed in the appendix. The text should be confined to general descriptions of major findings and a few tables that present outstanding summary results.

Funding Sources. Employer variables 18-26 relate to the employers' estimates of the approximate percent of current fiscal year project funds which come from various sources. The proportions of USOE and other Federal Agency funding to total funding should be examined to determine what is the average proportion and the distribution of proportion of (a) USOE and (b) all federal funding to total funding for projects. Characteristics of projects with (a) substantial proportions of non-federal funds or (b) many sources of funding, either federal or non-federal, should be examined to see if there are any identifying characteristics (e.g. size of project, institutional setting, project activity "type").

Project Period and Funding "Curves". The duration of a project and perception of funding level as increasing, level, or declining certainly conditions attitudes toward personnel and training requirements. It appears that it might be useful to partition projects by their duration (e.g. less than six months, 6-11 months, 12-17 months, 18-23 months, 24-29 months, 30 or more months). It might also be possible to look at the funding levels (on an annual basis) for all projects with more than one fiscal year of funding. Employer variables 15-17 request approximate funding levels from all sources for the current, the last fiscal year and the anticipated level for the next fiscal year. This information should be coded and used only after examining the project start and end dates. For projects with at least two years of funding the data provided by variables 15-17 (when placed on an annual equivalent basis if needed) could be used to define a set of "curves" defined by the three fiscal years (last, current, next), "modest increase" over the three years, "level funding," "up and down," etc.

The question for exploration is whether project duration or the experienced and anticipated funding curve is different for various types of projects, and more importantly what relation, if any, these two dimensions have to project and personnel characteristics and especially to personnel and training requirements?

Fiscal Projection. In the chapter on Preliminary Analysis and Planning, we presented arguments leading to the conclusion that long-term projection of educational RDD&E personnel and training requirements could probably only be made on a conditional or contingent basis, since these requirements are primarily influenced by federal policy. Hopkins, (1971) noted that even the federal educational R&D program managers were so decidedly uncertain of the future that most would project their funding expectations for only a few years and in only very general (and not very optimistic) terms. Our own limited field tests suggest that the RDD&E employer is no more prescient or sanguine. Consequently, we have laid our hope in the analysis of the present detailed structure of personnel, personnel requirements and training requirements *vis-a-vis* current project funding levels.

We have also asked employers questions concerning the probable nature of staffing increases if funding were increased 25% in the next year. At a gross level these two employer bases need to be examined for general compatibility.[5]

- current staffing at 100% current funding
- additional staffing plus current staffing at 125% current funding

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[5] Some employers may not respond carefully enough to question #6 (on additional staff if funding were increased 25%). Making allowances for salary differences, the 25% funding increase should result in approximately a 25% increase in staff. Questionable responses need to be checked with telephone calls or sequestered for special treatment.

The rationale behind the latter base is that employers may not be satisfied with their present mix of categories. If there are no major differences in proportions of employees by categories (professional, paraprofessional, technical, clerical), the current staffing base may be preferred.[6]

The next, and major, task is to partition the survey sample by relevant dimensions, which might be used to characterize probable project types that might be of interest to USOE or National Institutes of Education (NIE) planners. Probably the most useful dimension would be the empirically derived Project Activity "types" with cross breaks by substantive content area, e.g. experimental schools, career education, early childhood education (this dimension will show differences, probably not in dollars, but possibly in types of activity and hence personnel requirements, types of institutional setting, and relative funding size and duration of project).

For each of the "cells" generated by these cross breaks on pairs of dimensions[7], it would be desirable to establish say $100 thousand and $1 million units and then display relevant information regarding personnel requirements and training requirements for each. Consider the following hypothetical example:

* * * * * *

Applied R&D: Projection Requirements for Personnel and Training

General. Applied education R&D occures primarily in four institutional settings. By estimated 1972 dollar amount, they are: colleges and universities (%), R&D centers (%), educational laboratories (%) and non-profit organizations (%). Other organizations account for the remaining (%). There are distinct differences among these four settings in level of funding, size and composition of staff, and educational background and experience of staffs. Typically the colleges and R&D centers display a project and personnel activity profile that emphasizes a greater bias toward "conclusion oriented inquiry" activity and employ a greater number of part-time personnel(especially graduate students), whereas the educational laboratories and non-profit organizations show project and personnel activity with greater emphasis on "development" and tend to employ more full time personnel from a broader range of disciplines.

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[6] NSF data on FFRDC's shows an approximate 11% increase in ratio of "technicians" to FTE "scientists" over the 1969-1971 two-year period, hence looking for this difference in current and hypothetical 25% increases seems warranted.

[7] The very small number of projects or LEA units precludes much in the wayway of reliable estimation if the number of cells become too large, or more directly, the number of projects per cell become too small.

[8] The percentages will be derived from the survey results.

Profile differences are displayed in Figures _____ and Tables _____.

Figures and Tables here[9]

* * * * * *

Specific Personnel Requirements. Typical applied educational R&D staffing structures based on a $100,000 (1972) funding modulus are presented next.

A similar table could be prepared for training highlighting (a) critical skilos and sensitivities mentioned by Applied R&D type project employers in each setting and (b) areas of special interest in training and valued approach mentioned by employees working in these types of projects.

* * * * * *

Comments on Feasibility. Although the number of such tables would have to be limited, probably to major project activity types and priority substantive content areas, with cross tabulations by only institutional types, they would represent an important aid in assessing the possible consequences of proposed changes in federal R&D programs (new programs, increases or cuts in existing programs, shift in function emphasis e.g. from development to diffusion, etc.).

More important is the fact that if the right design is selected for the data bank and it is created, and maintained, then it would be possible to extract information on projects corresponding to specified program requirements and general tailor-made planning tables.

Whether "standard" or "tailor-made" tables are employed, tables similar to the above example should permit far more accurate estimates of personnel and training requirements than are currently possible. All that would be required is for the program planner to multiply the proposed (or appropriated) funding of the tabled figures to arrive at crude projection estimates based on current population parameters. These estimates can, of course, be refined by making adjustments based on the planner's judgment and experience. Essentially the method is that used by Clark and Hopkins (1969), but with a far more comprehensive and accurate data "base". If a biennial survey is inaugurated and if the population of RDD&E performers (employers and employees) is extended, then increasingly more comprehensive studies of the overall personnel and training should be attainable.

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[9] The figures and tables will be derived from the survey results.

	All Institutions	Colleges & Univ.	R&C Centers	Educational Lab's	Non-Profit Organizations
Total Number					
Professionals					
Paraprofessionals					
Technicians					
Clerical Staff					
Full-Time Equivalents					
Professionals					
Paraprofessional					
Technicians					
Clerical Staff					
Sex					
Men					
Women					
Degrees					
Doctoral					
Masters					
Bachelors					
Others					
Disciplines (Ph.D)					
Education					
Psychology					
Sociology					
...					
...					

Note.--These figures are equated to a GNP index of_____. For application in later years all ratios should be multiplied by the reciprocal of the ratio of the current GNP index to the 1972 GNP index, i.e.,

$$\left[\frac{1}{\text{Current GNP Index} \div \text{1972 GNP Index}}\right]$$

(This table can be continued for other personnel variables of interest, e.g., personnel activity profiles, turnover rates, etc.)

Local Educational Agency RDD&E (Chapter 3)

In the previous chapter of the analysis report school districts (LEA's) were treated as one of several settings for federally funded RDD&E activity, whether federally funded or not.

The chapter should describe the method of sampling, especially indicating if there has been a truncation of information regarding the very large number of school districts with enrollment below the selected cut off (e.g. 12,000 enrollment).

Because the outline for this chapter is parallel to that of anlaysis report chapter 2 and the recommended treatment is similar, we shall note only the more important issues. First, the institutional setting dimension disappears because there is only one setting. However it may be useful to routinely contrast LEA's with total data for all Federally Funded projects when this dimension is called for. This information can be summarized as illustrated in Table Shell 13. An added dimension is school enrollment size, which will probably show a marked relation to size of RDD&E staff and scope of RDD&E activity. In all probability there will be less of a difference in the LEA unit Activity Profiles (12 activities, employer variables 29-40) and possibly less in the Employee Activity Profile (25 activities, employee variables 61-75). Hence "types" may be fewer and less pronounced then in the case of Federally Funded agencies. The contrast of both Employer Activity Profiles and Employee Activity Profiles for LEA's should be made with the several "types" and the institutional settings of Federally Funded projects.

There may be special problems with the definition of part-time personnel, full time equivalents (FTE's) and RDD&E paraprofessionals and variable interpretations made by different reporting LEA's regarding numbers of part-time employees, FTE's and paraprofessionals. Special effort should be made to check on a sampling basis how these terms have been used and what precautions should be taken regarding their analysis. One of the most probable outcomes will be that quite different arbitrary interpretations will be made, usually underestimating the total number and the FTE number of persons involved in educational RDD&E. On the other hand, the size and composition of staffing will probably be much less variable than for Federally Funded projects.

The definitions RDD&E activities (Employer question #1) may themselves pose some problems in terms of their interpretation in a school setting. This is an area where further pilot testing of the questionnaire is warranted and where survey follow-up querry by telephone may be needed.

Having noted these points, it appears that the analysis of Chapter 3 should proceed much like that of analysis Chapter 2, with analysis and discussion of:

- employer characteristics
- employee characteristics
- personnel requirements
- training requirements

There seems to be less of a need or justification for a comparably extensive treatment of financial information. Certainly salary information should be examined. And, if adequate LEA RDD&E funding data is available, it should also be examined in order to provide some information concerning LEA RDD&E costs. On the other hand, analysis leading to the extensive financial projection tables recommended for Federally Funded projects does not seem warranted.

Summarization of major characteristics where there may be similarities or differences between LEA's and Federally Funded projects might be displayed as in Table Shell 13.

Special Personnel Populations (Chapter 4)

The status, characteristics, and requirements for racial minorities, women, paraprofessionals and part-time employees have been treated in the previous two chapters of the analysis report. However, the information on these special interest populations should be organized for special treatment.

Equal Opportunity and Affirmative Action

The survey contains information regarding numbers, professional status, employment status, salaries, job titles, number of persons supervised, job activities, job satisfaction, advancement possibilities, age, level of education, major areas of highest and courses taken, previous job experience, time in job, on-the-job training received, and interest in receiving further training all of which may be of special interest for affirmative action programs dealing with ethnic minorities or sex. It is suggested that tabular displays contrasting important variables be presented. This section needs to focus especially on where minorities and women are being employed and where they are not, and on any outstanding training requirements that are implied.

Paraprofessionals

Hood and Banathy (1970) found a marked contrast in the degree level required by academic as compared to industrial RDD&E organizations, and NSF data suggest educational RDD&E agencies use markedly fewer "technicians" than the other science agencies. It may be profitable to cross tabulate a variety of employee characteristics by the institutional setting and levels of professionalization dimensions to display any apparent pattern of differences in the way different institutions tend to define staff these categories or employ their professionals and paraprofessionals. Such an analysis could look at numbers, sex, level of education, years previous

Table Shell 13

Comparisons between RDD&E Performers in Local Educational Agencies and Federally Funded Projects in Other Institutional Settings

Characteristics	Local Educational Agencies	Federally Funded Settings
Numbers		
Number of projects in sample		
Projection to Population		
Number of Personnel in sample		
Projection to Population		
Project Characteristics		
Average Funding Level		
Range in Funding of Unit/Project		
Average Staff Size		
Range in Staff Size		
Staff Composition		
. . .		
Project Activities		
. . .		
Personnel Activities		
. . .		
Recruitment & Selection		
. . .		
Training Requirements		
. . .		

(relevant) experience, majors and courses, salaries, numbers of persons supervised, kinds of work performed, job satisfaction, advancement possibilies, turnover rates, projected hires (2 years and 25% increase) and training requirements.

Part-time Staff

The extent of use of part-time personnel, who they are, what kinds of institutions employ them, and in what capacity, deserves at least brief attention. The part-time graduate student, the instructional staff member who works part-time and the "full time" scientists who works on several projects are common occurrences on campus. Part-time staff also found other institutional settings. How much of the labor force is this group and what special training problems do they pose?

Comparisons to Other Data (Chapter 5)

Although this survey will be unique in its nation wide, probability sampling of employers and employees, it will be but one of many surveys and studies (see Chapter ______). If funds permit comparison to other studies should be undertaken.

The National Register

Although the last National Register of Scientific and Technical Personnel will be two years old, it may be instructive to compare the results of this survey with relevant data regarding scientists and engineers, especially those in psychology and the social sciences. NSF data on degree levels, scientific field, institutional setting, salaries, sex, age, and geographic location all offer opportunity for comparison.

APA Manpower Data System

If the plans of the American Psychological Association materialize, APA may generate a "census" of psychologists that will be contemporary with this porposed survey of educational RDD&E personnel. The information contained in the APA questionnaire is comparable to but more extensive than that in the National Register.

NEA Salary Survey

The biennial NEA survey of public-school professional personnel is confined basically to identification of the number of "administrative officers for research" and their salaries for all reporting school systems with enrollment over 12,000. Discrepancies with the NEA report should be noated and resolved, if possible. It is is found that the NEA survey is accurate in identifying districts with "substantial" R&D activity, the NEA survey might be used as a sampling frame.[10]

AERA and Oregon Studies

The results of this survey should be compared to the findings of these two massive studies of educational RDD&E. Special attention should be given to comparison to the Hopkins (1971) update of the Clark and Hopkins (1969) Manpower study and to the conclusions of both studies regarding needed training.

Appendices

The above discussion has recommended that most of the tabular results and other statistical information be placed in the appendix in order not to over buden the text itself. If this is done, the report will hopefully read _much_ more easily than the above description of the analysis and presentation may suggest. If possible, variances for some of the more important topics of data should be computed and presented _in this appendix_ for technical guidance in design of subsequent surveys.

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[10] Since NEA conduct its surveys in odd numbered years, a USOE biennial survey in eaven numbered years would be conveniently phased to use the NEA survey results. An RDD&E personnel item has been drafted and submitted for consideration in the ELSEGIS survey of elementary and secondary schools conducted by USOE, NCES. The ELSEGIS-RDD&E items could probably identify LEA's with RDD&E activity as well as or better than the NEA survey.

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Appendix A

LITERATURE SURVEY*

The literature on the training of educational researchers is now of moderate size; however, there is very little dealing systematically with the training of developers or disseminators. A perusal indicates four types of treatments:

Impressionistic descriptions of current status and prescriptions for improvement (e.g., Bereiter, 1965; Brim, 1958; Buswell, 1962; Clark & Guba, 1965; Fattu, 1960; Gage, 1962; Griffiths, 1963; Scates, 1947; Sieber, 1967; Stanley, 1962);

Studies of recruitment and training in other disciplines, notably sociology, psychology, social work, college teaching, law, medicine, and sciences (e.g., Barton & Wilder, n.d.; Berelson, 1960; Clark, 1957; Cooley, 1963; Holland, 1957; Kendal, 1961; Lortie, 1959; Merton, 1957; Roe, 1953; Selvin, 1962; Sibley, 1963; Stecklein & Eckert, 1958; Taylor, 1959; Thielens, 1957; Trow, 1963; Wright, 1956; House Comm. on Science & Astronautics, 1968; National Science Board, 1969);

Studies focusing systematically on the doctorate in education (Brown & Slater, 1960; Ludlow, Sanderson, & Pugh, 1964; Moore, Russell & Ferguson, 1960; and Yauch, 1961); and, finally,

Studies bearing directly on the training of educational research personnel (Buswell, McConnell, Heiss & Knoell, 1966; Fleury, Cappeluzzo & Wolf, 1970; Millikan, Wayland & Lazarsfeld, 1967; Sieber, Millikan & Wilder, 1964; Sieber & Lazarsfeld, 1966.)

Impressionistic Articles on Educational Research Training

The first of these four types of literature is predominantly impressionistic and exhortatory. Marked quantitative and qualitative deficiencies in educational research are recounted including: need for more funds and better students; the fragmentary, part-time state of affairs in educational research by faculty; isolation from the liberal arts and sciences; pressures for immediate application; need for long-range, programmed R&D, for better training curricula and more relevant R&D internships. This literature lays a base for understanding the problem, is notable in its failure to identify RDD&E needs other than in terms of "research", but provides little in the way of systematic examination.

Recruitment and Training in Related Fields

The literature on recruitment and training in related fields points to such factors as: the importance of the influence of undergraduate advisors and availability of research facilities; the need to identify research as a career and train for it as early as possible; the crucial role of a meaningful apprenticeship in R&D; and the need for an R&D orientation and adequate financial support for R&D in the graduate school.

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*This literature survey originally appeared in Hood, Banathy, et al (1970).

Graduate Training in Education

The third set of studies was sponsored primarily by the American Association of Colleges for Teacher Education and provides a wealth of findings and recommendations on student characteristics and institutional programs. They are chiefly valuable for their empirical and systematic corroboration of the impressionistic literature regarding the character of doctorate training in education.

Training of Educational Researchers

The findings of the fourth type of literature will be examined in more detail because of their greater relevance.

Buswell, McConnell, Heiss and Knoell (1966) based their investigation, in part, on parallel studies of research productivity of 818 persons receiving their doctorate degrees in 1954, and of 1750 persons receiving their doctorates in 1964. These two studies corroborate each other in finding that the more productive person was younger, had not specialized in education as an undergraduate, had been a full-time student, had participated in research during graduate training and had been an early publisher.

Krathwohl (1965) collected questionnaire data from 72 (of 104 in sample) institutions offering the Ph.D. or Ed.D. degrees in 1960. His questionnaire focused on the course patterns for training empirically oriented personnel vs. training methodologists or professors of research. Differences between these groups appeared in three dimensions: sophistication of research methods taught, extent of student exposure to a non-methodological area, and extent to which research experience other than dissertation is provided.

Sieber and Lazarsfeld (1964) studied 60 educational research bureaus in 36 universities to investigate the relationship between organization and the quality of research produced. Four impediments to research were identified: the conflict between services and research; failure to attract competent personnel into the field of education, then into educational research, and finally to retain them in university educational research; the fragmentary nature of faculty research due to teaching duties; and inadequate dissemination and utilization of research.

Sieber (1965) reported on training of graduate students in 76 education departments in 1963-64. Only 30% of the departments reported any arrangement for research training, and only 20% had special programs. The most frequently reported problems were: inadequate preparation of students for research, lack of financial resources, and low attraction of educational research for competent students.

Millikan, Wayland and Lazarsfeld (1967) undertook a major study to identify research preparation opportunities, to examine institutional and training arrangements that might relate to the production of researchers, and to investigate the commitment of recent doctoral recipients to educational research. The analysis was based on interviews with 20 persons, case studies of selected research organizations, content analysis of catalogues of 110 graduate institutions, and reanalysis of the Sieber and Lazarsfeld (1964) data. The major findings of this study were:

1. Productivity of researchers is high when institutions have a closed level of admission, a high proportion of faculty engaged in research, an emphasis on graduate preparation for research, a high level of apprenticeship, and a specific program for training researchers.

2. Production is very high when organizations have a systematic apprenticeship program and a high proportion of money for research.

3. A large volume of research activity poses problems in integrating and individualizing sufficiently the research experience provided.

4. Research organizations need autonomy from parent organizations so they may develop their own arrangements for research and training.

5. Training characteristics deemed most important are: student under age 32 at completion of doctorate, sufficient funds for scholarships or assistantships, involvement in interdisciplinary research, at least two types of research assistantship experience, less than 6 years in the education profession, and recruitment and orientation procedures to stress the importance of a career in R&D.

Hopkins and Clark (1969, pp. 45-46) have succinctly summarized these studies of the educational research community in the following manner:

> 1. Research in education had not been institutionalized--it was an individualistic pursuit.
>
> 2. The investigations were fragmentary and small scale efforts.
>
> 3. The educational researcher was a part-time functionary.
>
> 4. Most educationalists were not involved directly in the research field--their productivity as researchers was miniscule.
>
> 5. Change was slow to come to the field--despite increases in federal funds little difference could be observed from 1954 to 1964.
>
> 6. Research was not central to the operation of most schools of education and, inferentially, to the operation of elementary and secondary schools.
>
> 7. The input of new researchers to the field of education was small--probably not more than one of ten doctoral graduates.

8. The field was inhabited chiefly by researchers with a background in psychology or educational psychology.

9. Most of the research effort was university-based.

10. The research effort was centered for the most part in 10-20 universities offering the doctorate in education.

Manpower Requirements

Beginning with the post-Sputnik support of science and language curriculum reforms and impelled by funding under the Elementary and Secondary Education Act of 1965, there now exists a major demand for personnel qualified to perform at various professional and subprofessional levels across the entire research, development, dissemination and implementation continuum.

Projections of this demand made in an extensive study by David Clark and John Hopkins (1969) suggest that, compared with an estimated base of 4,125 persons in 1964, the most likely estimate for 1974 is 19,436 research, development and dissemination (RD&D) positions, approximately a five-fold increase. The minimum growth projected by Hopkins and Clark for the 1964-1974 period is three-fold and the optimum growth is seven-fold.

Under the minimum growth assumptions (which may be the most realistic), research positions are projected to decline from 95.6% of the total of RD&D positions in 1964 to approximately 38% in 1974, development positions are projected to increase to 45% of the 1974 total as compared to 3.2% in 1964; and diffusion positions are projected to be 15% of the total versus 1.2% in 1964. Under the most likely conditions, between 1964 and 1974, over 2,300 new developer and 850 new diffusion positions will be created. Under the least optimistic estimates, the increases are still substantial; 628 new developers and 229 new diffusion positions would be required.

Clark and Hopkins' analysis of the situation led to these conclusions:

> 1. The vacuum created by demand far exceeding available supply will be filled with whatever leadership and staff talent is available, whether or not that talent has any special qualifications for the new responsibilities.
>
> 2. The projects and programs supported by new funding programs will take on the characteristics of the personnel available to act as staff. Consequently, neither the agencies which provide the funds nor the institutions which adopt the new objectives of the funding agencies will, in fact, be able to secure the objectives established.
>
> 3. Serious slippage will occur in the measurable progress of RD&D organizations because of the time devoted to finding virtually nonexistent personnel. (Clark & Hopkins 1969, pp. 423-424.)

Recent Studies of Employers' Needs and Training Programs

Given the changing allocation of fiscal resources for educational R&D outlined by Hopkins and Clark (1969), it is clear that new requirements and needs for research, development, dissemination and evaluation talent are already perceivable. Among efforts to establish content substantive baselines for the manpower projections of Hopkins and Clark, the Task Force Survey of the American Educational Research Association (AERA) and the Survey of Fleury, Cappelluzzo, and Wolf are notable.

Fleury, Cappelluzzo, and Wolf (1970) obtained information about RD&D training, practices of current training programs, and expectations of potential employers from four sources: (a) all 85 graduate-level educational research training programs then supported by the U.S. Office of Education, (b) 47 (of 50) chief state school officers, (c) 178 (of 241) Massachusetts school superintendents and (d) 11 (of 15) prominent independent research institutes.

Their analysis of the responses leads to four major conclusions:

1. The evidence suggests there will be shortages of research, development and diffusion personnel in the field of education in the immediate future. The training programs are structured to supply candidates for conventional college level research positions, but are not meeting requirements for development and diffusion personnel. Although emplouers see a need for the technician-scholar in their agencies, the applied character of their work calls for more pragmatic employment practices.[1]

If the demand for RD&D personnel materializes, the 85 surveyed training programs may be able to service only the research training requirements well. In addition, surveyed employers may be called upon to initiate intensive inservice training programs to meet their own requirements.

2. The personnel requirement projections for the immediate future imply a need for programs at other than the doctoral level. A master's level or six-year program is needed and employers are receptive to hiring such personnel. Yet only 8 of the 85 programs provide subdoctoral programs.

3. Trainers and employers seem to be working at cross purposes in terms of selection, job responsibilities, and exposure to the field of education. Presently the trainers are oriented primarily to college and university employment positions.

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[1] This kind of finding is not confined to education. In a major survey of technological manpower needs of industry, it was found that "While industry prefers to hire technological personnel from university sources, the current limited number available from the university sources obliges industry to resort to a form of industrial cannibalism." (Jacobs & Swanson, 1966, p. 210.)

4. While colleges and universities will continue to absorb most of the "R" talent, they are in direct competition with local, state and federal education agencies and independent [and commercial] research agencies for the few "D&D" specialists trained each year. As the demand for "D&D" personnel rises, provisions will have to be made for their training.

One study of the AERA Task Force on Training Research and Research-Related Personnel study (Sanders & Worthen, 1970) relied on telephone interviews with a selected sample of 58 persons who either employed or supervised research or research-related personnel in one of 10 types of institutional settings. One third of the respondents were in University settings with the remainder from laboratories, R&D Centers, independent research organizations, education agencies, etc. As the authors note, some of the data they present is difficult to summarize, but it is clear that the employers ranked three of the four evaluation functions (context evaluation, input analysis, and process evaluation) highest, followed in order by development, outcome evaluation, research and diffusion. However when frequency with which functions were listed as the most important is examined, the order of importance becomes development, research, context evaluation, product evaluation, diffusion tied with input analysis, and finally process evaluation.

It is difficult to do justice to the wealth of detail contained in the Sanders and Worthen report, but what clearly emerges is the high importance which these employers attached first to evaluation and then to development, followed in order by research and diffusion.

Also emerging from this study is the fact that persons located in each of the ten types of institutional settings may engage in a wide spectrum of R&D functions. The priorities placed on functions may differ with the institutional setting, but all the seven major functions are relevant to programs in any of the institutional settings:

> In terms of relative importance, it appears that evaluation, development and research rank in that order, but all are high and close together on the scales used. Conversely, diffusion is viewed as relatively less important by a majority of the interviewees...Perhaps the proliferation of roles for diffusers embodied in current literature on educational change is prophetic rather than descriptive of present professional priorities.
> (Sanders & Worthen, 1970, p. 35)

As a methodological note, Sanders and Worthen made the observation:

> It seems desirable to have practitioners in research and research-related activities project training needs for the future, rather than depending on opinions of those removed from practical realities. (Sanders & Worthen, 1970, p. 38)

Since the Fleury, Cappelluzzo and Wolf study noted that few O.E.-sponsored programs did, in fact, deal with "D" or "D", and the AERA study may have inadequately sampled employers with direct interest in dissemination (Sanders & Worthen, 1970, p. 35), the survey of organizational arrangements and training programs for R&D utilization by educational practitioners accomplished by the Far West Laboratory's Communication Program (York, 1968) provides supporting information. Based on a year-long search of the literature and follow-up correspondence, 80 exemplary organizational arrangements and 24 training programs were selected, described and evaluated.

York concludes:

> Our current information indicates that no single training program is providing school research personnel with the necessary skills across the entire knowledge utilization continuum....Presently the most adequate training being provided school research personnel is in the area of evaluation techniques and research design skills. This conclusion is in agreement with the findings of last year's surveillance report (Carlisle, 1967). While last year's report concluded that information utilization skills were the most inadequately developed areas of training, our current information indicates that the skills in which the least training is being provided are (1) needs assessment, (2) long-range planning, and (3) systematic analysis of present conditions. (York, 1968, pp. 9-10)

Reanalysis of the information in the York report (Hood, 1969) shows that only three knowledge utilization functions, dissemination, field testing, and evaluation of test results, were supported by more than half the educational R&D utilization organizational arrangements. Notably absent were provisions for long range planning, present condition analysis, needs analysis, problem formulation, and decision making. Less than a fourth of the arrangements provided for these functions. The picture for the 24 exemplary training programs is remarkably similar to that of the organizational arrangements. Training in conduct of experiments or field testing, and in evaluation of results, are the two predominant subject areas. None of the programs explicitly treats design and conduct of demonstrations of exemplary educational products and practices, only two of 24 dealt with training in needs analysis or decision making, and less than a fourth dealt with such subjects as long-range planning, present condition analysis, problem formulation, information research, information interpretation, dissemination or implementation.

Appendix B

MANPOWER RESOURCES
IN EDUCATIONAL R&D IN THE UNITED STATES[1]

Estimates of trained manpower available to perform educational research and development are extremely hard to come by. Definition of role is crucial. Defining the topics and concerns that might be covered by the term "educational research" is equally important. Actually locating and counting such people is difficult even when these two parameters are defined.

A Beginning Estimate of the Manpower Supply for Educational Research

The analysis developed in this section is drawn from chapter 2 of the study recently completed by David L. Clark and John E. Hopkins, A Report on Educational Research, Development, and Diffusion Manpower, 1964-1974.[2]

As part of their report Clark and Hopkins present the most detailed manpower analysis of the educational research community that exists. The analysis is based on 1964 data and is consequently somewhat out of date. The Federal funds for educational research and development have increased by a factor of at least five, an increase which has surely had some impact on the size of the manpower pool today. Since their analysis is the best that exists, we have made use of it, keeping in mind that it is necessarily a minimum picture at this point in time.

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[1] Reproduced from Educational Research and Development in the United States (Gideonse, 1969, pp. 117-124).

[2] Bloomington, Ind.: Indiana University Research Foundation 1969

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TABLE 32.–SAMPLE OF R,D, AND D PERSONNEL BY AGENCY SETTING AND FUNCTIONAL JOB EMPHASIS–1964*

Setting	R, D, D Program Dirs. and Staff				R,D,D, project directors and staff	R,D,D, training program directors and staff	Individual R,D,D Personnel				Stimulators and coordinators of R, D, and D activities	Total
	Outside-funded	Res. and service bureaus	Institutional research	Sub-total			Hard-core prod.	Reg. prod.	Occa. prod.	Sub-total		
Colleges and Universities												
Schools and Colleges of Education	7	124	3	134	39	--	42	187	440	669	15	857
Schools and Depts. of Psychology	1	48	1	50	14	1	19	107	168	294	----	359
Other Behavioral and Social Science Depts.	1	45	------	46	11	--	32	76	100	208	1	266
Other Discipline and Academic Areas	--	14	------	14	7	1	13	37	62	112	10	144
College and University Administration Units	--	2	62	64	1	--	------	5	35	40	5	110
Sub-total	9	233	66	308	72	2	106	412	805	1,323	31	1,736
Federal Agencies												
U.S. Office of Education	--	18	2	20	------	--	21	31	16	68	9	97
Military Agencies	--	14	7	21	2	--	4	1	1	6	3	32
Other Federal Agencies	--	16	3	19	1	--	9	5	12	26	4	50
Sub-total	0	48	12	60	3	0	34	37	29	100	16	179
State Agencies												
State Departments of Education	--	36	11	47	3	--	2	5	13	20	4	74
Other State Agencies	--	8	------	8	12	--	1	5	22	28	2	50
Sub-total	0	44	11	55	15	0	3	10	35	48	6	124
Schools and School Systems												
Local Public School Systems	--	1	117	118	10	--	1	7	47	55	3	186
Other Schools and School Systems	--	2	26	28	------	--	------	------	6	6	----	34
Sub-total	0	3	143	146	10	0	1	7	53	61	3	220
Private Research Institutes and Agencies												
Private Research Institutes	--	87	------	87	2	--	2	2	1	5	2	96
Private Social Service and Welfare Agencies	--	9	------	9	1	--	4	6	7	17	1	28
Sub-total	0	96	0	96	3	0	6	8	8	22	3	124
Professional Associations												
Professional Education Associations	--	42	------	42	4	--	------	------	------	------	----	46
Related Professional, Public, Lay Assoc.	--	9	1	10	1	--	------	------	------	------	----	11
Sub-total	0	51	1	52	5	0	0	0	0	0	0	57
Inter-Agency Organizations												
Educational Laboratories	--	------	------	------	------	--	------	------	------	------	----	0
Other Inter-Agency Organizations	--	24	------	24	4	--	------	------	------	------	----	28
Sub-total	0	24	0	24	4	0	0	0	0	0	0	28
Private Foundations	--	1	------	1	1	--	2	------	------	2	3	7
Business and Industrial Organizations	--	45	------	45	2	--	0	------	------	0	0	47
Total	9	545	233	787	115	2	152	474	930	1,556	62	2,522

*From David L. Clark and John E. Hopkins, "A Report on Educational Research, Development, and Diffusion Manpower, 1964-1974," p. 76.

time. The data reported by Clark and Hopkins draw heavily upon three empirical studies of researchers in education: by Sam Sieber, by Robert Barger and associates, and by Guy Buswell and associates.[3]

At the beginning of the decade of the 1960's two prominent educational researchers attempted to typify the world in which they were living. Griffiths in 1959[4] and Fattu in 1960[5] found that the number of personnel involved in educational research was small and that the work produced seemed not only to have little impact on the behavior of professionals in the field but also to add little to education's knowledge base.

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[3] Sam D. Sieber and Paul Lazarsfeld, *The Organization of Educational Research in the United States,* Cooperative Research Project No. 1974, New York: Bureau of Applied Social Research, Columbia Univ., 1966, 364 pp.; Robert Bargar, Egon Guba and Corahann Okorodudu, *Development of a National Register of Educational Researchers,* Cooperative Research Project No. E-014, Columbus, Ohio: The Ohio State University Research Foundation, 1965, 139 pp.; Guy T. Buswell, T. R. McConnell, Ann M. Heiss, and Dorothy M. Knoel, *Training for Educational Research,* Cooperative Research Project No. 51074, Berkeley, California: Center for The Study of Higher Education, Univ. of California, 1966, 150 pp.

[4] Daniel E. Griffiths, *Research in Educational Administration: An Appraisal and a Plan,* New York: Bureau of Publications, Teachers College, Columbia University, 1959, 59 pp.

[5] Nicholas A. Fattu, "The Role of Research in Education–Present and Future," *Review of Educational Research,* Vol. 30, No. 5, December, 1960, pp. 409-421.

The Buswell and Sieber investigations of the early 1960's substantially validated the essentially impressionistic reports of Griffiths and Fattu. Buswell found the field of educational research composed mainly of fragmentary, small-scale investigations; also, nearly one-third of a sample of 818 education doctorates received in 1954 had no research publications. One hundred respondents pointed to a single research publication and another hundred could list two or more.

The Griffiths, Fattu, Buswell, Sieber, and Barger studies together indicated that:

- Research in education had not been institutionalized. It was an individualistic pursuit.
- The investigations were fragmentary and small-scale efforts.
- The educational researcher was a part-time functionary.
- Most educationists were not involved directly in the research field and their productivity as researchers was miniscule.
- Change was slow to come to the field. Despite increases in Federal funds little difference could be observed from 1954 to 1964.
- Research was not central to the operation of most schools of education and, inferentially, to the operation of elementary and secondary schools.
- The input of new researchers to the field of education was small, probably not more than one of 10 doctoral graduates.
- The field was inhabited chiefly by researchers with a background in psychology or educational psychology.
- Most of the research effort was university based.
- The research effort was centered for the most part in 10 to 20 universities offering the doctorate in education.[6]

In developing their analysis, Hopkins and Clark discovered that no single body of empirical data available to, or collected by, the survey staff yielded a clear picture of the number of persons who might be classified as research, development, and diffusion (R, D, and D) personnel in education in 1964. Consequently, they engaged in comparisons, examination, and reanalysis of the extant data in an effort to define and refine the number of persons within each personnel group. Clark and Hopkins first examined the Buswell and National Register studies (Bargar) to establish the absolute base for the number of R, D, and D personnel in education in 1964. In other words, their initial assumption was that the problem lay not in justifying the inclusion of an individual case identified, for example, by Buswell, but rather in determining the number of cases not picked up in the Buswell or National Register studies.

Clark and Hopkins' careful analysis of the Buswell, Bargar, and Sieber data is summarized in table 6.[7] On the basis of these data Clark and Hopkins characterized the educational R, D, and D community in the United States in 1964 in the following way:

- The preponderance of R, D, and D personnel in 1964 was located in college and university settings, functioning as individual researchers in a part-time basis.
- Most individual researchers reported devoting part time to R, D, and D activity, and the modal time reported was very much part time—one-fifth to one-third time.
- Research personnel located in schools of education were most likely to be spending a small percentage of time on their research activity.
- Within the college and university setting 50 percent to 60 percent of the R, D, and D personnel were affiliated organizationally with a school or college of education.
- USOE research personnel in 1964 were either working as social bookkeepers or as specialists conducting discrete studies in substantive areas.
- State department of education personnel were chiefly normative researchers employed in research divisions.

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[6] Clark and Hopkins, *op. cit.*, pp. 45-46.

[7] *Ibid.*, p. 76.

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- Schools and school systems were represented by some teachers, counselors, and administrators working for a small percentage of their time on R, D, and D projects and by data gatherers functioning in a research division.
- Few development and diffusion personnel seemed to be functioning in the R, D, and D community in 1964, and even fewer were identified through the questionnaire and search techniques employed in the study.[8]

Beginning from the base estimate established in table 32, Clark and Hopkins then extended their analysis to establish an overall estimate of R, D, and D personnel in education. Clark and Hopkins in effect rebuilt table 32 to reflect not just the actual number of respondents to the Bargar study but an estimate of the total field based on all available data for July 1, 1964. Basing their reanalysis on the Sieber study, the Buswell study, personnel reports of the U.S. Office of Education, the Bean study of State educational agencies, the NEA Research Division study on Research Units in Local School Systems, the annual reports of AIR and ETS, and other publications, Clark and Hopkins produce a final estimate of 4,125 R, D, and D personnel in education. This estimate is detailed in table 33.[9]

Additional Estimates of Related Manpower

Some additional perspective can be lent to the picture of available manpower by examining data which exists on graduate students and trained professionals in academic disciplines relevant to educational research and development. Two sources have been employed: the report of the National Register of Scientific and Technical Personnel; and the reports of the National Center for Educational Statistics (USOE) on earned degrees conferred in higher education.

The National Register data are based on questionnaires returned by almost a quarter million scientists in 1966, three-fifths of whom were in the physical sciences, one-fourth in the life sciences, and the remainder in the social sciences. These 243,000 respondents constitute 67 percent of the number to whom questionnaires were sent, from a list developed in cooperation with participating academic societies.

Respondents were asked to indicate their field of greatest scientific competence, taking into consideration their training and work experience. The figures reveal that 8 percent of the respondents identified their scientific field as psychology, 5 percent as economics, 1 percent as sociology, and 1 percent as linguistics and anthropology. This response is for all degree levels.[10]

Among the doctorate holders in the sample, 12,545 (14 percent) were in psychology, 5,593 (6 percent) in economics, 2,757 (3 percent) in sociology, 830 (1 percent) in anthropology, and 750 (1 percent) in linguistics.[11]

Among the master's degree holders 6,075 (9 percent) were in psychology, 4,658 (7 percent) were in economics, 780 (1 percent) were in sociology, and a total of 401 (5 percent) were in linguistics and anthropology combined.[12]

Respondents holding only the bachelor's degree were negligible in the fields of interest here, except for economics which listed 2,660 individuals.[13]

Additional information can be found in the estimates of recent degrees conferred and degree candidates in disciplines relevant to education R&D.

Using a USOE report of earned degrees conferred in 1966-67,[14] and estimating that only 10 percent of those earning doctorates in education will be candidates for research careers, we arrive at the following approximations:

Education[15]	353
Linguistics	70
Psychology (all fields)	1,231
Anthropology	136
Economics	546
Sociology	327
Total	2,663

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[8] *Ibid.*, pp. 74-75.

[9] *Ibid.*, pp. 105-106.

[10] *American Science Manpower 1966: A Report of the National Register of Scientific and Technical Personnel (NSF 68-7)*, U.S. Government Printing Office, Washington, D.C., 1967, p. 15.

[11] *Ibid.*, p. 25.

[12] *Ibid.*, p. 28.

[13] *Ibid.*, p. 31.

[14] *Earned Degrees Conferred: 1966-67, Part A—Summary Data*, U.S. Government Printing Office, Washington, D.C., 1968, pp. 12-18.

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TABLE 33.–ESTIMATED NUMBER OF R, D, AND D PERSONNEL BY AGENCY SETTING AND FUNCTIONAL JOB EMPHASIS–1964*

Setting	R, D, and D program directors and staff	Stimulators and coordinators of R, D, and D activities	Individual R, D, and D Personnel			Total
			Hard-core producers	Regular producers	Occasional producers	
Schools and Colleges of Education	160	40	115	265	620	1,200
Schools and Departments of Psychology	70	----	46	150	234	500
Other Behavioral and Social Science Departments	64	1	60	106	139	370
Other Discipline and Academic Areas	20	14	28	52	86	200
College and University Administration Units	150	----	------	7	48	205
U.S. Office of Education	35	20	31	46	23	155
State Departments of Education	240	10	25	25	65	365
Schools and School Systems	265	5	10	120	140	540
Private Research Institutes and Agencies	300	----	------	------	----	300
Professional Education Associations	90	----	------	------	-----	90
Inter-Agency Organizations	50	----	------	------	-----	50
Business & Industrial Organizations	150	----	------	------	-----	150
Total	1,594	90	315	771	1,355	4,125

*From David L. Clark and John E. Hopkins, "A Report on Educational Research, Development, and Diffusion Manpower, 1964–1974," pp. 105-106.

Similar approximations for a later year can be derived from fall, 1967, enrollment data.[16] Again using the 10 percent estimate in education, the figures below show potential researchers expected to complete doctoral requirements by June 30, 1968, in academic disciplines related to education.

Education[15]	396
Linguistics	133
Psychology (all fields)	1,450
Anthropology	216
Economics	706
Sociology	457
Total	3,358

USOE Manpower Development Activities in Educational R&D

Under the provisions of the amendments to the Cooperative Research Act contained in title IV of the Elementary and Secondary Education Act of 1965, USOE was authorized to establish training programs for research and research-related personnel.

Six types of programs have been supported over the past 4 fiscal years (1966-1969). These are:

- Undergraduate training programs to recruit capable career researchers.
- Graduate training programs, awarded through graduate schools, to increase the flow of competent research personnel.
- Postdoctoral grants to help update the skills of educational researchers and to

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[15] The figures for education represent 10 percent of the totals on the grounds that this proportion is a fair approximation of research degrees in this field. Figures in other disciplines are totals.

[16] *Students Enrolled for Advanced Degrees: Part A–Summary Data, Fall 1967.* Washington, D.C., U.S. Government Printing Office, 1969, pp. 9-11.

B 6

TABLE 34.–USOE EDUCATIONAL RESEARCH TRAINING PROGRAM

Program	1966		1967		1968		1969(est.)	
	Trainees	Cost*	Trainees	Cost*	Trainees	Cost*	Trainees	Cost*
Undergraduate	134	$ 256	116	$ 108	------	$ -----	------	$ ------
Graduate	732	4,385	794	4,837	809	5,049	809	5,200
Postdoctoral	41	621	13	265	20	397	20	400
Institute	1,635	1,425	1,011	453	1,462	459	1,750	400
Special Project	------	------	------	------	------	91	------	100
Program Development	------	591	------	241	------	167	------	650
Totals	2,592	$7,278	1,934	$5,904	2,291	$6,164	2,579	$6,750

*In thousands of dollars

acquaint trained researchers in other fields with research in education.

- Institutes which provide short-term intensive training in particular aspects of research.
- Special projects, including seminars, workshops, personnel exchanges, inservice training programs, and other nondegree training.
- Program development grants to strengthen college and university staffs and to develop curriculums for training in education research.

The funding levels, awards, and number of trainees in each of these programs for the past 4 years are shown in table 34.

In recent months Sam Sieber completed an analysis of the USOE research training programs which provides data to supplement the figures.[17]

Sieber's report covers the first year of the USOE training program, 1966-67. He found that a comparison of the geographical distribution of trainees with the distribution of USOE-funded research positions, the distribution of public school pupils, and the distribution of educational researchers at large showed that the distribution of trainees more closely conforms to that of public school enrollment than to that of educational researchers.

More researchers are being trained in the South; there are more researchers working in the Northeast. From the viewpoint of serving the research needs of schools, Sieber found this situation to be good, since it showed that USOE programs are compensating for the disproportionate number of researchers in the Northeast.[18]

Sieber found that the great majority of graduate training programs are located in departments of education. Moreover, only about 40 percent of the graduate programs entailed interdisciplinary training. He found that the graduate training programs are more often located in institutions of higher quality and in universities that promise the strongest programs of research training. Since the better schools are more likely to have already emphasized scholarship and training for research, training programs tended to be located at such schools.

Another finding of the Sieber study was that only a small proportion of graduate programs are operated by research bureaus or centers. (It might be noted that this finding is of some cautionary significance in view of Buswell's study of research productivity of doctorates which suggested that one of the most important parts of training is work in a research organization.) Sieber also found that none of the directors of training programs was primarily affiliated with a research unit; they were predominantly located in teaching departments. Training directors were more often professional educators or researchers at large. When they mentioned a nonprofessional field, it tended to be professionally oriented, e.g., educational psychology.[19]

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[17] Sam D. Sieber, *Analysis of U.S.O.E. Training Programs,* Bureau of Applied Social Research, Columbia University, January 1968, CRP Project No. 7-8315.

[18] *Ibid.*, pp. 8, 11, and 12.

[19] *Ibid.*, pp. 29, 34.

With the exception of trainees in the undergraduate program Sieber found that the majority of trainees had held a degree for several years. For the graduate programs this fact is indicative of the familiar feature of career lines in education—the interruption of studies for employment. Of the graduate students, 84 percent were employed at some time since completion of their last degree. Thus, there has been considerable discontinuity in educational career lines. Only a small minority of trainees in any program (except the postdoctoral) held research-related jobs in the recent past. The USOE training programs, however, seemed to be serving a need in helping graduate students pursue their future studies without interruption. But Sieber questioned how much commitment to research careers could be assured in view of the considerable amount of time which trainees had spent away from the university setting, particularly in teacher or administrator roles.[20]

The average age of the graduate trainees—29.1—makes it apparent that the USOE program is making a contribution to lowering the age of the doctorate in education. Sieber estimates that the graduate trainees will be receiving their degrees about 7 years earlier than the general doctorate student in education.[21]

Nonetheless, the number of graduate trainees with dependents raises the question whether they are sufficiently unencumbered by family obligations to devote their fullest attention to their studies.[22]

From other data Sieber concludes that there is little emphasis on training for research administration, a situation which he believes needs correction, and that while trainees as a whole tended to be more "field oriented" than "academic oriented," graduate trainees were divided about equally between these two types, with slightly more academically oriented researchers.[23]

A reassuring finding, however, was that three-quarters of the graduate trainees were seeking the Ph.D. rather than the Ed.D.; since Ph.D. recipients are more likely to engage in research than Ed.D. recipients, Sieber viewed this trend as promising substantial payoff.[24]

Sieber directs some attention to the criticism that educational research lacks the perspective of the basic social science disciplines, as indicated by the paucity of theoretically guided research and development. He notes that most studies of research training conducted indicate that the largest category of educational research personnel is persons with backgrounds in professional education and that the level of interdisciplinary research in education is low. Although an effective means of imbuing educational research with the social science perspectives lies in recruiting more social scientists, especially in the nonpsychological disciplines, the great majority of USOE research training programs in departments of education, and the majority of trainees (75 percent), designated a field in professional education.[25]

Summary and Conclusions

In fiscal year 1968 the United States expended $250 million on educational research and development. Using the latest figures available Clark and Hopkins estimate a 1964 manpower pool of 4,125 full-time equivalent persons. Estimating the cost per full-time professional at approximately $30,000 at that time, it is apparent that the real investment in 1964 in educational research and development was somewhere in the neighborhood of $124 million. Since Federal and private foundation sources accounted for no more than one-third or two-fifths of that amount, the remainder was obviously met by State or local sources or by donated services out of other budget categories (e.g., instructional costs for higher education).

The fiscal year 1968 sponsored investment for educational R&D represents, after a 20 percent correction for inflation and overdue salary increases in higher education, an expansion of some 70 percent. The increasing dollar flow from sponsoring agencies, however, can in part be accounted for by noting that support for R&D which used to take the form of matching local contributions from the performing agency is increasingly being replaced by monies from the sponsoring agency.

One inescapable conclusion is that a heavy press currently exists on the trained personnel available. Some of this slack has been taken up by the entry of personnel into educational research from other academic disciplines and from industry. Some has been taken up by the addition of a growing number of recent doctoral recipients. A great portion has been taken up by on-the-job training of individuals, particularly in the fields of development, dissemination, and diffusion, who have assumed newly identified and defined roles in educational research and development. Finally, the increase in the manpower utilized is also partially explainable in terms of the increased scale of R&D work which has contributed to greater cost and a larger number of lower technical roles without necessarily creating additional demand for highly trained researchers.

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[20] *Ibid.*, pp. 47-51.
[21] *Ibid.*, p. 77.
[22] *Ibid.*, p. 82.
[23] *Ibid.*, pp. 85, 88.
[24] *Ibid.*, p. 57.

[25] *Ibid.*, p. 68.

The manpower supply situation does not appear likely to improve very substantially as one looks at the projected outputs of the present level of educational research training supported by USOE. While the doctoral programs will be supplying 250 to 300 new people a year and larger numbers are receiving short term training, these numbers will be insufficient to sustain any large-scale expansion of the R&D effort.

Appendix C

SURVEY AND ANALYSIS OF MANPOWER REQUIREMENTS IN R,D&D

Beginning with the post-Sputnik support of science and language curriculum reforms and impelled by funding under the Elementary and Secondary Education Act of 1965, there now exists a major demand for personnel qualified to perform at various professional and subprofessional levels across the entire research, development, dissemination and implementation continuum.

Projections of Demand

Clark and Hopkins (1969), in an extensive study, made projections suggesting that in comparison with an estimated base of 4,125 persons in 1964, the most likely estimate for 1974 is 19,436 research, development and dissemination (R,D&D) positions. This is approximately a five-fold increase; the minimum growth projected for the 1964-1974 period is three-fold and the optimum growth is seven-fold.

Under the minimum growth assumptions (which may be the most realistic), research positions are projected to decline from 95.6% of the total of R,D&D positions in 1964 to approximately 38% in 1974, development positions are projected to increase to 45% of the 1974 total as compared to 3.2% in 1964; and diffusion positions are projected to be 15% of the total versus 1.2% in 1964. Under the most likely conditions, between 1964 and 1974 over 2,300 new developer and 850 new diffusion positions will be created. Under the least optimistic estimates, the increases are still substantial; 628 new developers and 229 new diffusion positions would be required.

Clark and Hopkins's analysis of the situation led to these conclusions:

> 1. The vacuum created by demand far exceeding available supply will be filled with whatever leadership and staff talent is available, whether or not that talent has any special qualifications for the new responsibilities.
>
> 2. The projects and programs supported by new funding programs will take on the characteristics of the personnel available to act as staff. Consequently, neither the agencies which provide the funds nor the institutions which adopt the new objectives of the funding agencies will, in fact, be able to secure the objectives established.
>
> 3. Serious slippage will occur in the measurable progress of R,D&D organizations because of the time devoted to finding virtually non-existent personnel. (Clark & Hopkins, 1969, pp. 423-424.)

Recent Studies of Employers' Needs and Training Programs

Given the changing allocation of fiscal resources for educational R&D outlined by Hopkins and Clark (1969), it is clear that new requirements and needs for research, development, dissemination and evaluation talent are already perceptible. Among efforts to establish content substantive baselines for the manpower projections of Hopkins and Clark, the Task Force Survey of the American Educational Research Association (AERA) and the Survey of Fleury, Cappelluzzo, and Wolf are notable.

Fleury, Cappelluzzo, and Wolf (1970) obtained information about R,D&D training, practices of current training programs, and expectations of potential employers from four sources: (a) all 85 graduate-level educational research training programs then supported by the U.S. Office of Education, (b) 47 (of 50) chief state school officers, (c) 178 (of 241) Massachusetts school superintendents and (d) 11 (of 15) prominent independent research institutes.

Their analysis of the responses leads to four major conclusions:

1. The evidence suggests that there will be shortages of research, development and diffusion personnel in the field of education in the immediate future. The training programs are structured to supply candidates for conventional college level research positions, but are not meeting requirements for development and diffusion personnel. Although employers see a need for the technician-scholar in their agencies, the applied character of their work calls for more pragmatic employment practices.[1]

If the demand for R,D&D personnel materializes, the 85 surveyed training programs may be able to service only the research training requirements well. In addition, surveyed employers may be called upon to initiate intensive inservice training programs to meet their own requirements.

2. The personnel requirement projections for the immediate future imply a need for programs at other than the doctoral level. A master's level or six-year program is needed and employers are receptive to hiring such personnel. Yet only 8 of the 85 programs provide sub-doctoral programs.

3. Trainers and employers seem to be working at cross purposes in terms of selection, job responsibilities, and exposure to the field of education. Presently the trainers are oriented primarily to college and university employment positions.

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[1] This kind of finding is not confined to education. In a major survey of technological manpower needs in industry, it was found that "While industry prefers to hire technological personnel from university sources, the current limited number available from the university sources obliges industry to resort to a form of industrial cannibalism." (Jacobs & Swanson, 1966, p. 210.)

4. While colleges and universities will continue to absorb most of the "R" talent, they are in direct competition with local, state and federal education agencies and independent (and commercial) research agencies for the few "D&D" specialists trained each year. As the demand for "D&D" personnel rises, provisions will have to be made for their training.

Sanders and Worthen (1970), in a study for the AERA Task Force on Training Research and Research-Related Personnel, relied on telephone interviews with a selected sample of 58 persons who either employed or supervised research or research-related personnel in one of 10 types of institutional settings. One third of the respondents were in university settings and the remainder from laboratories, R&D centers, independent research organizations, education agencies, etc. As the authors note, some of the data they present is difficult to summarize but it is clear that the employers ranked three of the four evaluation functions (context evaluation, input analysis, and process evaluation) highest, followed in order by development, outcome evaluation, research and diffusion. However when frequency with which functions were listed as the most important is examined, the order of importance becomes development, research, context evaluation, product evaluation, diffusion tied with input analysis, and finally process evaluation.

It is difficult to do justice to the wealth of detail contained in the Sanders and Worthen report, but what clearly emerges is the high importance which these employers attached first to evaluation and then to development, followed in order by research and diffusion.

Also emerging from this study is the fact that persons located in each of the ten types of institutional settings may engage in a wide spectrum of R&D functions. The priorities placed on functions may differ with the institutional setting, but all the seven major functions are relevant to programs in any of the institutional settings. As a methodological note, Sanders and Worthen observed, "It seems desirable to have practitioners in research and research-related activities project training needs for the future, rather than depending on opinions of those removed from practical realities.

York (1968) provides supporting information in a survey of organizational arrangements and training programs for R&D utilization by educational practitioners. Based on a year-long search of the literature and follow-up correspondence, 80 exemplary organizational arrangements and 24 training programs were selected, described and evaluated. York concludes:

> Our current information indicates that no single training program is providing school research personnel with the necessary skills across the entire knowledge utilization continuum....Presently the most adequate training being provided school research personnel is in the area of evaluation techniques and research design skills. This conclusion is in agreement with the findings of last year's surveillance

> report (Carlisle, 1967). While last year's report concluded that information utilization skills were the most inadequately developed areas of training, our current information indicates that the skills in which the least training is being provided are (1) needs assessment, (2) long-range planning, and (3) systematic analysis of present conditions. (York, 1968, pp. 9-10)

Hood (1969) reanalyzed the information in the York report and concluded that only three knowledge utilization functions, dissemination, field testing, and evaluation of test results, were supported by more than half the educational R&D utilization organizational arrangements. Notably absent were provisions for long-range planning, present condition analysis, needs analysis, problem formulation, and decision making. Less than a fourth of the arrangements provided for these functions. The picture for the 24 exemplary training programs is remarkably similar to that of the organizational arrangements. Training in conduct of experiments or field testing, and in evaluation of results, are the two predominant subject areas. None of the programs explicitly treats design and conduct of demonstrations of exemplary educational products and practices, only two of 24 dealt with training in needs analysis or decision making, and less than a fourth dealt with such subjects as long-range planning, present condition analysis, problem formulation, information research, information interpretation, dissemination, or implementation.

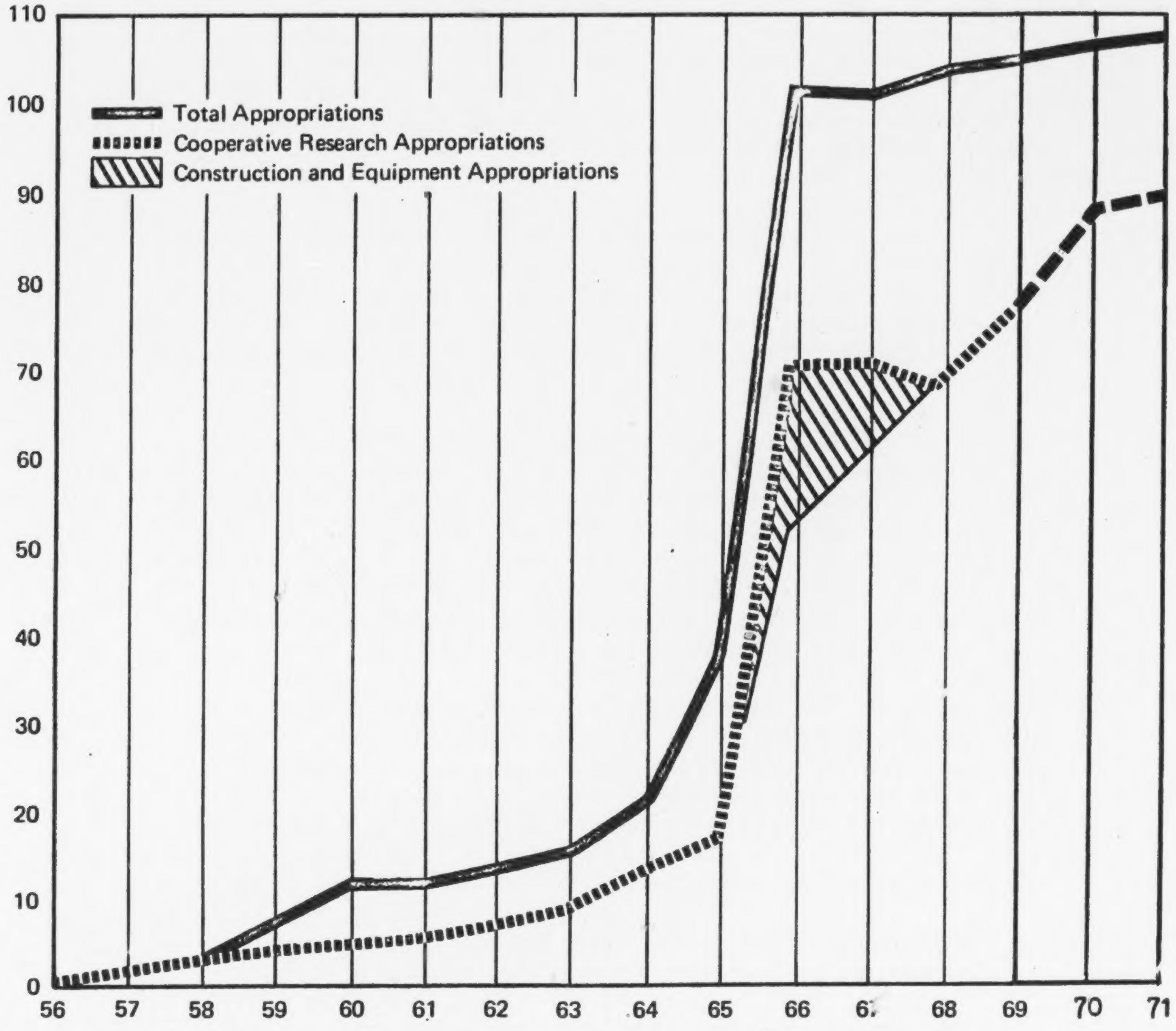
Gideonse (1969, p. 115), on the other hand, uses a figure which when extended to FY 1971 (Figure 1) shows a major discontinuity in O.E. "Research and Training" funds between FY 1965 and 1966. Since FY 1966 there has been an almost level rate of total expenditure, which, when discounted at the conservative 5% inflation figure chosen by Clark and Hopkins, is actually seen as a loss. To cite Rogers and Worthen's analysis of 1968-1970 AERA employment service data:

> The reversal of trends between 1969 and 1970 is startling. The market for research and research-related personnel is down in virtually all areas, doubtless due to reduced funding of critical research programs. This has resulted in less demand in research, development, and diffusion than even the most pessimistic projections of Clark and Hopkins (1969).
>
> (Rogers & Worthen, Sept. 1970, p.10)

Figure 1

APPROPRIATIONS FOR "RESEARCH AND TRAINING"

U. S. OFFICE OF EDUCATION, 1957-1969 + 1970, 1971



Reexamination of Projections

To return then to the Clark and Hopkins projections, we find them both more optimistic and more narrow than seems warranted based on 1970 information. The analysis rests on the explicit assumption,

> that the limitations imposed upon program growth and expansion during fiscal years 1967-1969 are viewed as unusually stringent and will not be continued during the period FY 1970-1974. (Clark & Hopkins, p. 121)

In point of fact these stringent levels continued into FY 1970 and 1971, and there was no clear evidence that conditions for FY 1972 would be markedly better. In fact, as noted above, the almost constant dollar level implies a diminishing actual level due to inflation.

To provide a range of possible endpoints Clark and Hopkins make three projections: "Least Optimistic," "Most Likely," and "Most Optimistic."

> Except when available information indicated that a program was being reduced or phased out . . . it did not appear reasonable to assume that a program (over time) would fall below its current level, however. As a result, the Least Optimistic projection exhibited the funds needed to support a FY '68 level of operation.
>
> . . . Readers who do not wish to accept the caveat to the general assumption underlying the study (i.e., that the unusually stringent funding support for FY '67-'69 will be increased during FY '70-'74) may rely on the Least Optimistic projection to furnish them a description of the situation which will exist in 1975 if funding awards are not increased beyond what is needed to maintain current levels. (pp. 127-128)
>
> In order to use the best data available, a Least Optimistic projection of future funding was prepared for each program by adding a numerical constant of five percent per year to the FY '68 funding of the program and to each year thereafter . . . . (p. 141)

Clark and Hopkins comment:

> Since funds have been tight for two or three years, it may be of interest to examine the projected situation should funds remain tight. Only the educational laboratories and vocational educational R&D centers would grow significantly. The subunits most adversely affected would be the regular D and D projects, the RCU's (again, a special case), and small and regular RD&D projects.
>
> A characterization of the situation depicted might be as follows:

> Development and diffusion programs and projects are to be given the greatest support.
>
> If funds remain tight, the support given development and diffusion will be at the expense of research projects.
>
> Programs are to be supported beyond projects.
>
> Since the more expansive programs are in new settings (laboratories, public schools) and directed toward new objectives (special D and D projects, clearinghouses), the near future will be a period of turbulent organizational and change roles.
>
> ESEA-created and fostered programs will be leading the press for organizational and role change. (pp. 231-232)

Seen from a slightly later perspective, these observations are generally valid. In terms of relative gains, R,D&D in support of handicapped children has been a more significant gainer than the laboratories, but certainly development and diffusion have gained relatively at the expense of research (and training).

The Clark and Hopkins analysis starts from the baseline projection of personnel who are supported by the sample of USOE and NSF programs included in the study. It then proceeds to logically derived projections of growth in populations of R,D&D personnel not included in the baseline sample (i.e., to include such areas as business and industry).

When these projections are carried out for the Least Optimistic projection, we derive (Table 1) from the results reported in Tables 80 and 83 of the Clark and Hopkins Report:

Table 1

Estimated Number and Percent of Positions in RD&D for 1964 and 1974

	Research	Development	Diffusion	Total
1964 Estimated Number	3,944	132	49	4,125
1964 Percentage	95.6	3.2	1.2	100.0
1974 Least Optimistic Projection	4,874	5,772	2,181	12,827
1974 Least Optimistic Percentage	38.0	45.0	15.0	100.0

The immediate implication of this table is that the threefold increase projected for total R,D&D from 1964 to 1974 (if FY '72-'74 does not see appreciable funding increases over the FY '68-'71 levels) will have a substantially different impact on R,D&D positions. New positions and percent increases over 1964 positions will then be: research, 930 new positions (24%); development, 5640 new positions (4273%); and diffusion, 2132 new positions (4351%).

Projections of this demand suggest that, compared with an estimated base of 4,125 persons in 1964, the most likely estimate for 1974 is 19,436 research, development and dissemination (R,D&D) positions, approximately a five-fold increase. The minimum growth projected by Hopkins and Clark for the 1964-1974 period is three-fold and the optimum growth is seven-fold.

Under the minimum growth assumptions (which may be the most realistic), research positions are projected to decline from 95.6% of the total of R,D&E positions in 1964 to approximately 38% in 1974, development positions are projected to increase to 45% of the 1974 total as compared to 3.2% in 1964; and diffusion positions are projected to be 15% of the total versus 1.2% in 1964.

Taking note of the large numbers of positions projected by Clark & Hopkins (1969, Table 80, p.282) under Least Optimistic conditions for research institutes and agencies (2400) and for business and industrial organizations (1200) we turn to their discussion of these two employment categories.

> Personnel in private research institutes (e.g., American Institutes for Research, Science Research Associates) and in private social service and welfare agencies . . . identified in 1964 were 300, all of whom were categorized as program personnel. It appeared . . . that the prospects for growth in this setting were excellent . . .
>
> The final projections, then, were derived by computing an increase . . . of 800 percent for the least optimistic . . . (p. 275).

Regarding business and industrial organizations,

> This setting was not strongly represented in either the 1964 description or the baseline projections. The former suggested there were no fewer than 150 R & D persons in this setting; the latter, because there were no persons in this setting in the USOE or NSF proposals sampled in FY '66, projected no persons in this setting. The size of the investment being made by major corporations indicated that the number of positions supported by business in industrial organizations in 1974 would be many times the combined totals of the 1964 description and baseline projections . . . (pp. 278-279)

On the basis of one study (Phi Delta Kappan, Sept. 1966, p. 22) reporting a projected increase of from $500 million in 1966 to $5-to-$10 billion in 1976, an 800 percent increase was projected under the Least Optimistic conditions.

As we shall note later, there is reason to believe that the narrow definition of educational R & D persons employed, as well as the specific points of departure for this study may have led to serious underestimation of both the private and the business R & D enterprise in 1966. For instance the professional staffs of AIR, SRI and HumRRO, to mention only the members of the Far West Consortium who were involved in educational or training R & D in 1966 approached 300. Further when one examines only the demand for personnel and training R & D generated within industry by defense and aerospace contracts in 1964, the figure of 150 appears as a gross underestimate. The Systems Development Corporation alone (which in 1964 might have been classified as a private research institute, but is now a profit making corporation) employed more R & D training personnel than this.

In both of the above examples we have deliberately extended the arena for "educational R,D&D" to include training and social systems R,D&D. Certainly, for purposes of projecting the manpower and training requirements for R,D&D personnel supporting elementary, secondary and higher education, this does not seem warranted. But if we consider the total national manpower resources available and the competing markets for trained R,D&D personnel in education and training it seems provincial to project the employment demand only in terms of the needs of elementary, secondary and higher education.

Comparison of Estimates Based on Clark and Hopkins to Those of Gideonse

By reference to an estimated Least Optimistic projection (OE and NSF only) of 5,131 positions at $148,019,000 (Clark and Hopkins, p. 249) we arrive at a FY '74 cost of $28,848 per full time professional position. Then referring to the Least Optimistic final projection for all personnel of 12, 827 positions in 1974, we arrive at an estimated 1974 dollar cost of $370,033,000. Finally adjusting this 1974 figure back to 1968 (at 5% compounded discount rate) we arrive at $262,976,000. The import of this figure is seen by reference to Gideonse (1969, Table 31, p. 117) which provides a documented minimum base of financial support for educational research and development by sponsoring agency in FY 1968 at $192,290,000 and an estimated expenditure of $250 million (Table 2).

Gideonse notes:

> In sum, the amounts on Table 31 document the absolute minimum amount expended on educational research and development activities in the United States in fiscal year 1968. A conservative additional estimate based on the five conditions stipulated above [private foundations support more than is reported to Science Information Exchange (SIE), the absence of abstracts from the Department of Defense to match the probable R & D level of activity, some ESEA Title I and

> III activities are under represented, very little reporting from industry to SIE, some SIE and NSF abstracts reported unknown funding level] would be the documented base total about 25 percent. We judge, accordingly, that approximately $250 million was spent on educational research and development activities in the United States in fiscal year 1968. (Gideonse, 1969, p. 117)

Table 2

Documented Minimum Base Financial Support for Educational Research and Development by Sponsoring Agency

Agency	FY 1968
United States Office of Education	$101,967,000
National Science Foundation	23,326,000
National Institute of Mental Health	11,860,000
National Institute of Child Health and Human Development	8,377,000
Office of Economic Opportunity	12,800,000
Department of Defense	6,046,000
Other Federal Agencies (Labor; Commerce; Children's Bureau; Agriculture; Social Rehabilitation; Interior; and Endowments for Arts and Humanities)	6,725,000
Private Foundations	7,344,000
All Other (State agencies; higher education institutions; professional and academic associations; etc.)	13,845,000*
Total	192,290,000

*The SIE-and DDC-collected material produced a figure somewhat lower than this. To it have been added amounts equal to available NSF figures representing the fiscal year 1965 obligations of State agencies and fiscal year 1967 local government agency obligations for educational R&D.

Although Gideonse's estimate of $250 million is simply a 25% increase over the documented financial support in 1968, the Clark and Hopkins Least Optimistic projection (discounted at 5 percent per year) leads to a remarkably similar figure of $263 million. The immediate implication seems to be that unless there is a substantial increase in educational RDD&E funding for FY '72-'74, the Least Optimistic estimate provided by Clark and Hopkins may be quite reliable for making the national manpower projection.

Gideonse observes:

> In fiscal year 1968, the United States expended $250 million on educational research and development. Using the latest figures available Clark and Hopkins estimate a 1964 manpower pool of 4,125 full time equivalent persons. Estimating the cost per full time professional at approximately $30,000 at that time it is apparent that the real investment in 1964 . . . was somewhere in the neighborhood of 124 million.
>
> The fiscal year 1968 sponsored investment . . . represents [after corrections for inflation] . . . an expansion of some 70 percent . . . .[2]
>
> One inescapable conclusion is that a heavy press currently exists on the trained personnel available. Some of the slack has been taken up by the entry of personnel into educational research from other academic disciplines and from industry. Some . . . by . . . recent doctoral recipients. A great portion . . . by . . . on-the-job training, particularly in the fields of development, dissemination and diffusion. . . . Finally, the increase in the manpower utilized is also partially explainable in terms of . . . a larger number of lower technical roles without necessarily creating additional demands for highly trained researchers. (Gideonse, 1969, pp. 123-124)

Gideonse's last point prompts us to return a moment to the Clark and Hopkins study to note that it seems apparent that their projections deal almost exclusively with "professionals" since their projections lean so heavily on the National Register of Educational Researchers (Bargar et al., 1965; Hopkins and Clark, 1969, Appendix A and Appendix F). The 1964 figure of $30,000 per full time professional (Gideonse, 1969, p. 123) or the 1974 figure of $28,848 calculated above, p. D6, tends to confirm this impression. What then, accepting either Hopkins and Clark's or Gideonse's figures, is the demand for paraprofessionals?

Experience in industrial hardware development indicates a range of 0.51 to 1.94, technician per professional engineer (Jacobs & Swanson, 1966). A quick check of the five developers in the Far West Consortium indicates that for every doctorate or master's level professional there are 0.54 persons at B.A. level and below who are serving in paraprofessional support

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[2] Gideonse's estimate of approximately $30,000 per full time professional in 1964 is grossly above the Clark and Hopkins data, which suggest a similar figure ($29 to $30 thousand) for 1974. Their base number of persons and funding base lead to a figure for 1966 of $20,225 (4263 positions at $86,223,000). (Clark and Hopkins, pp. 237 and 230.) If this figure is discounted at 5% to 1964 we derive a figure of $18,344 which is substantially lower than $30,000.

(not secretarial) positions, and our survey of nearly one thousand D,D&E positions in the San Francisco Bay Area region shows that for every doctoral or master's level professional, there are 1.22 persons at the B.A. level and below.

As will be seen in our job and task analysis, there is every reason to believe that, given proper training, the ratio of paraprofessional to professional can be effectively increased to meet projected D,D&E demands.

Far West Regional Requirements

There was a need to establish the size and characteristics of the regional demand for D,D&E personnel within the immediate future in order to (a) establish that there would be a demand of sufficient size to warrant the creation of viable training programs within the Far West Consortium region, and (b) provide rough estimates of the ability of the United States to support several such consortia. The need for estimates of demand in order to justify the creation of a training program within a college or university is quite obvious. The second kind of estimate is also important since this proposed model is based on the assumption that its long-range cost-effectiveness is dependent on transportability to several other regions where a similar demand may exist.

In order to establish an estimate of regional demand and to identify prospective employers an extensive effort was undertaken to establish who were the employers of educational and training RDD&E personnel in northern California, and especially in the greater San Francisco Bay area. Names of prospective employers were compiled from personal knowledge of consortium members, from professional and organizational directors, from the Foundations Directory (1970) and from USOE Current Projects Information (July, 1970).

Through October 21, 1970, 115 organizations and firms were contacted, with 34 reporting that they employed personnel in educational or training R, D, D or E. These employers indicated that they currently employed 985 professionals or paraprofessionals in educational or training work and that their estimated need for new employees in this field for 1971 and 1972 would total 255. These preliminary survey returns are examined by level of training in Table 3.

Table 3

Currently Employed and Projected Hires 1971 and 1972 by Professional Level

Levels	Currently Employed	Projected New Positions 1971-72
Doctorate	178	40
Masters	268	89
Bachelors	319	78
High School & Some College	220	48
Total	985	255

When the numbers presented in Table 3 are reexamined to estimate how much of this demand exists in terms of "educational" and federally supported RDD&E (elementary, secondary or higher eduation as well as military training) versus the business and industrial training sector, we find the following (Table 4):

Table 4

Comparison of Educational and Other Federally Supported Versus Business and Industrial Training Demands for RDD&E Personnel in the San Francisco Bay Area

	Educational and Federally Supported		Business and Industrial Training	
	Employed	Projected Hires	Employed	Projected Hires
Doctorate	98	17	80	23
Masters	115	26	153	63
Bachelors	98	21	221	57
High School or AA	42	14	178	34
Total	353	78	632	177

These results suggest that the market for trained personnel is substantially larger than might be estimated if only a narrow concept of "educational" R and D is taken. In the San Francisco Bay Area region current and projected new employment at doctoral levels in the business and industrial sector is almost as large as all other educational and federally supported sectors, and it is markedly larger for the sub-doctoral levels.

Perspective on Manpower Transfer between Educational RDD&E and Business/Industry

As Gideonse noted, "Some of this slack has been taken up by the entry of personnel into educational research from other academic disciplines *and from industry*" (italics ours). The manpower transfer between educational R and D and industrial (or military) training R and D is obviously a two-way flow which will depend on the market. Presently it is possible that those entering educational D,D&E from military or industrial training settings may have a marked advantage in experience over the "educational researcher." Given more effective patterns for training educational D,D&E personnel, it seems equally obvious that the business and industrial training employer will be competing with the "educational" employer for the available trained talent. From the Office of Education perspective, this may be a sobering prediction. Certainly, it raises serious questions regarding who benefits from heavy OE investments in traditional graduate programs and post doctoral grants.[3]

Six brief examples may illustrate the concept of an RDD&E component which could be included in career training programs of the late 1970's and beyond in the modern labor market of the United States.

Police science. Law enforcement departments at all levels would benefit significantly from the technical competence and awareness of one or more officers trained in research, data development, community survey techniques, analysis of data, storage and retrieval of information and information dissemination.

Computer Programming. Nearly all trainees in computer science would benefit from a scientific and detailed program training component focusing on RDD&E procedures. Computer programming on a national scale at the present time suffers from inadequate preparation of programmers in organization of data, research techniques and dissemination of information.

Transportation Careers. Movement of passengers and freight, particularly air freight, is dependent upon skilled technicians who need many of the skills involved in RDD&E procedures. Thousands of trainees in this rapidly expanding field could benefit from a well-developed, rigorous RDD&E training component tailored to meet transportation program needs.

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[3] Gideonse gives data suggesting that the 1968 or 1969 cost of USOE educational research training programs was approximately $6,300 per trainee in a graduate program and $20,000 per trainee in a post-doctoral program. (Gideonse, 1969, p. 122)

Aviation Careers. Movement of people and materials through the air is growing at such a rapid rate that not only are airports and planes unequal to the task but also support personnel on the ground are lacking in required technical competence. Effective data input and use of information systems are critical in aviation. Employees of the future will need training of the kind proposed for an RDD&E skills component.

Business Management and Marketing. Particularly in the "crossroads-of-the-world" of the San Francisco Bay Region, the major employment field is wholesale and retail business operations. Marketing, processing and manufacturing industries of the future will require literally thousands of persons trained in the techniques of marketing research, survey techniques, computer information systems, identifying significant data and decision making based upon computerized information sources. A training component based upon performance objectives in RDD&E skills and aimed toward individualized development can make a significant contribution toward the improvement of business and industrial operations.

Education, Social Welfare and Civil Service Agencies. An RDD&E training program with spiral curriculum components focusing on professional and paraprofessional careers in public service is essential for orderly growth of research, development and dissemination services in these public agencies.

We have reason to believe that the "industrial cannibalism" observed among hardware-oriented R & D firms in their recruitment of engineers and technicians trained largely on the job by other firms (Jacobs & Swanson, 1966) will also be encountered in the educational, training and social systems RDD&E arena also. From the standpoint of national welfare, we are concerned with the quality of this total RDD&E manpower pool. From the standpoint of the college or university, asked to inaugurate a program in "educational D,D&E" it is reassuring that a sufficient demand for graduates in a specific geographic area can be projected. But for the special interest of the U.S. Office of Education, whether these interests be broad or narrow in their perspective, the paramount concern may be that of finding the most cost effective solution to assuring supply of trained personnel to meet priority needs of educational RDD&E.

Summary

In this analysis of manpower requirements we have tried to make the following points:

At least through FY 1971 Clark and Hopkins' expectations, that the limitations on expansion during FY '67-'69 were transient and that continuation over any extended period of time was unlikely, was overly optimistic. In fact, as Gideonse graphically shows (Figure 1, p. 6), the sudden increase in OE appropriations for "research and training" between FY '65 and FY '66 was the unusual element, and since FY '66, for six years now, the real, uninflated dollar value of the total appropriations has in fact declined. Consequently for the OE and NSF projects considered in Hopkins and Clark's study, their Least Optimistic estimates may be the most accurate and instructive. The analysis by Gideonse tends to corroborate this Least Optimistic figure.

Appendix D

EDUCATIONAL RDD&E TRAINING DESIGN STUDIES

In December, 1970, twelve agencies submitted design proposals to USOE for programs to train personnel in development, dissemination and evaluation skills to prepare them for work in educational agencies. These design reports were based, in part, on some sort of analysis of personnel and training needs. This appendix abstracts the material from each design report which relates to its analysis of those needs.

The report of W. James Papham at U.C.L.A. (1) based most of its analysis on studies published in the late '60's. It cites the AERA Task Force on Training of Educational Researchers (Sanders and Worthen, 1970) and two further studies based on AERA employment service data (Worthen and Sanders, 1970, and Oldefendt and Worthen, 1970) which indicate heavy demands for development and evaluation personnel. Francis Chase's (1968) report is cited as evidence that educational laboratories have had difficulty in "securing trained personnel to carry out the functions for which they were responsible." Papham cites Clark and Hopkins's (1969) manpower analysis as observing that the 1974 demand for research, development and diffusion personnel is likely to be five times the 1964 demand with no increase in training output. USOE's Educational Research and Development in the U.S. Gideonse, 1969, and Glaser's (1966) and Evans's (1969) papers are referred to as statements about the inadequacy of current training efforts in educational research and development. U.C.L.A. sent exploratory letters to 300 agencies and individuals describing its proposed training program in development and evaluation. From the 91 responses received, 79(or 87%) responded positively to the question, "Is there any likelihood, if our agency is set up and functioning as of summer, 1971, that your agency would wish to use the services of our program?" There was also an open-ended query about the nature of these agencies training needs. Data from responses to the latter question are not presented in the report.

The report of the Colorado Center for Training in Educational Evaluation and Development (2) presents working papers submitted by seven of the consortium agencies in which personnel needs are described for the areas of evaluation, development, diffusion and clerical staff. The Design Report does not include a compilation of data, but the figures for five of the agencies (two did not respond with specific estimates) can be found in appendices A, B, D, F, and G, sections I A and I B. There is no consistent use of job categories; this make a compilation of the information difficult, but possible.

The Midwest Educational Training Center's design study (3) reports on a need study done for the five-state area of Minnesota, Iowa, North Dakota, South Dakota and Wisconsin in the following types of agencies: (a) local, intermediate and state education agencies; (b) regional labs and R&D centers; (c) colleges and universities; (d) educational or training divisions of industrial firms. The study was not a survey of agency directors' stated needs, but judgments of informed experts from the Minnesota Department of Education about personnel likely to be needed. Results of the study are presented in METC's Design Document I of its four-volume report.

The report from Syracuse University's Center for Evaluation and Research Training (4) mentions conduct of a market survey to determine needs and capabilities of its consortium members (public schools, government agencies and educational industries). The survey indicated that all cooperating institutions saw needs for evaluation, dissemination, development and research personnel in that order. The need for personnel at the three levels of (a) independent investigator, (b) role definition personnel or dependent professional and (c) paraprofessional was also indicated. The Design Report does not have any specific information on the type of survey (interview, questionnaire, specific categories of questions) nor does it present the actual data derived from the survey.

Pittsburgh's Learning Research and Development Center (5) conducted an interview study of tasks performed by research assistants at LRDC to derive data on development tasks, and a "parallel" investigation of tasks at Research for Better Schools provided data on diffusion tasks. Task lists from representatives of school systems within the project consortium provided data on design and implementation tasks. Three products resulted from this research: (a) a set of working definitions of development, diffusion, utilization, evaluation and research, (b) a comprehensive list of tasks in educational R&D (but with no data on frequency or relative frequency of occurrence of these tasks), and (c) a working paper using behavioral analysis techniques to identify the skills which are involved in the curriculum development process. No information was presented about current or projected manpower needs.

For the Southwest Educational Development Laboratory's design (6), personnel needs in RDD&E were assessed through in-depth interviews conducted on a nation-wide basis in 21 selected institutions engaged in one or more aspects of research, development, diffusion, or evaluation. In the survey analysis, more information was presented on training-level needs than on what specific job categories reflected greatest need for trained personnel. The survey revealed that:

1. No agencies had formal, highly-structured training programs for college graduates and beyond.
2. Nine agencies had informal or loosely-structured programs at the on-the-job (in-house) level and also supported attendance at outside seminars or conferences.
3. Six agencies reported that they had only informal on-the-job training.
4. Two agencies reported on-the-job training and a "continuing education" program.
5. Three agencies reported on-the-job training programs for high school or two-year college personnel in data processing.

In addition, their review of the professional literature revealed that personnel competent in the following skill areas are in very high demand, while the supply is limited:

(1) Conceptualizing issues and processes in education

(2) Designing techniques to carry out educational goals

(3) Setting educational objectives

(4) Measuring and evaluating educational outcomes

(5) Summarizing and communicating outcomes

(6) Implementing outcomes

(7) Identifying and incorporating attitudes, values, and practices of minority groups in the educational process.

The Far West Laboratory's report (7) describes a mixed approach to job and task analysis for its D,D&E training program. It included a literature survey and analyses; retrospective analysis (interviews and conferences with a number of experts, followed by circulations of the derived list of competencies to D,D&E supervisors for comment on frequency of performance, educational level available, and educational level actually required); time sampling of 40 persons working on 28 D,D&E projects in three major agencies; and a task inventory survey administered to 40 persons working on 32 D,D&E projects. Results are summarized in Vol. I, Chapter 6, and presented in greater detail in Appendix E of Vol. II, of the Design Report.

Tuskeegee Institute's report (8) did not include any surveys of its own; a literature search was conducted. The report refers primarily to Clark and Hopkins's study (1969), especially to their documentation of increased need for development and dissemination personnel.

PEDR Urban Associates (9) surveyed a random sample of thirty unified and non-unified school districts from seven Southern California counties. Enrollments in the districts were between 6,000 and 700,000 students. Structured interviews were conducted with all but two of the superintendents. The superintendents indicated a profound need for improving communication with the commuity and with school staff, and they sensed the importance of providing strong leadership in developing more effective educational delivery systems. To meet these needs, the superintendents interviewed said they are willing to hire technical and professional organizational specialists from outside sources such as government, colleges, private consulting firms, and educational agencies. They are interested, as well, in an in-service training program to train top staff as organization specialists.

The Ohio State University Evaluation Center (10) developed a number of instruments to determine manpower needs in educational RDD&E. In addition to their work, the Ohio Consortium conducted a questionnaire survey of 100 school administrators to assess the number of job opportunities available to the graduates of an undergraduate training program in research and development. The survey was designed to obtain three types of information: (a) types of research and development positions presently existing in Ohio public schools; (b) An assessment of the number of positions open to graduates of the program; (c) Suggestions and reactions from administrators and research directors concerning the purpose and content of the training program. Sixty-four of the 67 returned questionnaires contained usable responses. Conclusions were that only the larger school districts would be able to offer positions, these positions being equally divided between research and evaluation titles; and that the hires would likely be in a dual role of teacher/R & D personnel.

In addition to a very thorough literature search, the Ohio Center's evaluation of training needs in the area of RDD&E included the following techniques:

1. A series of interviews with consortium members, members of the consortium'sdecision-making team, experts in RDD&E, and relevant community agencies.

2. A questionnaire survey to assess manpower needs in 15 regional educational laboratories.

3. Use of Delphi technique and a decision-makers' conference (including RDD&E personnel and employers and trainers of these personnel) to obtain role descriptions and perceptions of needs, problems and potential solutions pertaining to training.

4. Case studies of three outstanding programs in the areas of RDD&E to ascertain specific skills needed by each agency as well as information on common skills used in RDD&E to be used as criteria for recruitment and selection of trainees.

The questions used and the results of the interviews with eight consortium members are reported on pp. 10-47 of Vol. III of the Design Report. No tabulations were made of the responses in the interest of "clarity and preservation of the diverse and various types of data."

The detailed results of the literature search are presented on pp. 48-69 of Vol. III, with a brief summary presented on pp. 20-29 of Vol. I of the report.

Two rounds were completed of the Delphi technique for reaching group consensus on a list of program objectives useful in developing an RDD&E training program. The resulting list and the priorities established are found on pp. 71-75 and in Addendum IV of Vol. III of the Design Report.

Pages 76-134 present detailed information derived from interviews with directors of three agencies. This material is presented in the form of case studies, with the following suggested conclusions:

1. Quantitative skills were rated high in importance; quantitative analysis was not done with great frequency; quantitative design skills were used with greater frequency.

2. Managerial and budgetary skills were rated of high importance and frequent use.

3. Interpersonal and communication skills were rated as highly important

and frequently used.

4. Career development patterns had not been carefully planned from the start.

5. Perceptions of career goals were not clearly defined.

The complete checklist of skills used in the case studies may be found on pp. 191-209 of Vol. III of the report.

The survey of the 15 regional laboratories elicited information from employees on their work activities; and from directors, data relating to the activities, training areas, employment trends and needs for educational specialists within the educational laboratory network. Data are presented on pp. 141-154 of Vol. III. For this survey two instruments were developed, the Professional Employee Profile and the Director's Questionnaire. They are presented in Addenda VII and VIII of Vol. III of the Design Report.

No manpower surveys were reported by either Indiana University or the Pacific Northwest Training Consortium.

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Appendix E

DESIGN FOR RDDE STUDY

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1. Introduction

The overall sampling procedure that is recommended is that of stratifying the projects by a measure of size and, then, sampling projects at random without replacement within strata,(1) and subsampling persons at random without replacement from the projects. Sampling with probability proportionate to a measure of size of project(2) is feasible but has not been recommended because the available measure of size may be poor, and because the use of ratio estimates will recover much of the efficiency otherwise lost.

A possible difficulty caused by using the project rather than the organization as a sampling unit is that the same person may be in more than one RDDE project. Hence, a person may be eligible for selection and selected more than once for the sample. Consequently, the lists of those selected from the same organization should be compared and overlapping eliminated. The use of multiple frame techniques(3) is possible but too complex for description here.

It would also improve the estimation procedure if each person were asked to state the proportion of his total time spent on RDDE activities in the project from which he is selected. For certain tabulations, it will be desirable to use these proportions rather than to count that person in the same way if he spends 10 percent, as if he spends all his time on that project.

Except for non-response and use of weights to account for overlapping personnel, the design is intended to yield self-weighting estimates. If non-response and weighting are not highly variable, it may be possible to use the data without weighting, at least for preliminary results. Non-response is likely to be high in a mail survey such as this. Non-response is likely to vary by size of project and, possibly, other characteristics. Stratifying by size makes it more reasonable to accept those responding as an approximation to the entire stratum. If other modes of stratification to which non-response might be associated should be practicable they also should be used. Non-response of more than 30 percent seriously affects that credibility of a survey, in my judgement. Either by mail follow-up or by telephone or personal interviews, a response rate of at least 70 percent should be the target. All formulae have been given in terms of actual frequencies rather than sampling ratios to permit adjusting for non-response through weighting.

2. Sampling Procedures

Before stratifying projects by size, other modes of stratification may be adopted, for example, stratification by region of the country. These stratifications are assumed to have been done before stratifying by size.

The sampling will then be done in the following steps:

a. A measure of size obtainable for each project will be used. For population segments the measure of size will be the funding of the project on an annual basis.

b. Cumulative subtotals of the measures of size for each stratum will be made beginning with the smallest size on up to the largest size.

The grand total, T, for each stratum will be divided by 10 if stratification by size into 10 strata is used.

Stratification by size of project is now defined:

(1) Stratum_1 consists of the smallest projects whose total size approximates* $\frac{S}{10}$.

(2) Stratum_2 consists of the smallest projects not in Stratum_1 whose total size approximates* $\frac{S}{10}$.

(3) The following strata are similarly defined. Stratum_{10} consists of the largest projects.

The above technique of stratification by size is not necessarily optimum.(4) Others having more efficiency may be stated. But the above method is simple to apply, and the measures of size being used are not necessarily themselves ideal for the purposes of the survey.

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*Approximation is necessary because the sizes will not coincide with multiples of $\frac{S}{10}$. In the largest strata one should include the project in the stratum if the multiple $\frac{S}{10}$ occurs within the project size.

Sampling ratios for projects within each stratum will be established as follows:

a. An overall sampling ratio, r, of persons is established by estimating the number of RDDE personnel in the population and the desired size of sample.

b. Within the stratum, S_{10}, of largest projects, each project is in the sample. Within each project the ratio, r, of persons is selected.

c. Within stratum S_9, half the projects are in the sample. Within each selected project the ratio 2r of persons is selected.

d. Within stratum S_8, 1/4 the projects are in the sample. Within each selected project the ratio 4r of persons is selected.

e. Within stratum, S_7, the sampling ratio of projects is $\frac{1}{2^3}$ and of persons within selected projects is $2^3 r$.

f. The procedure continues for strata $S_{10-i}, i=3,4,\ldots,10$ until $2^i r$ exceeds 1. For all strata with $2^i r \geq 1$, all RDDE personnel in the selected projects are in the sample and the proportion of projects selected in each such stratum is r.

Substitution for refusals ordinarily produces biases of unknown types and sizes. It is important to take whatever steps are possible to obtain cooperation. Mail and telephone followups, and if needed, an interview subsample of non-respondents should be considered.

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*It is assumed that the sampling procedure will occur in 2 stages except for strata in which all RDDE personnel in a selected project are in the sample. In the first stage a questionnaire will be sent to the project in order to determine the RDDE personnel on the project. In the second stage the within project sampling will occur.

3. Estimation of Expected Values and Variances of Totals

The procedure given below provides formulae for estimating means and variances for the four population segments defined in I a, b, c, d. Estimates desired for these four populations combined can be obtained by adding the estimates for each and the variances will be the sum of the variances. However, the use of the project as a sampling unit will lead to double counting unless each respondent is asked to state how much of his time he spends on RDDE for each of the four sources. This subject is not further considered here.

The number of strata is denoted by K. The number of projects in stratum k is denoted by M_k and the number of projects in the sample from stratum k is m_k. The number of RDDE personnel in project i of stratum k is N_{ki} and the number in the sample is n_{ki}. The value of variables, x, y for person j of project i of stratum k are denoted by x_{kij} and y_{kij} respectively.

(5) Ramdom subgroup methods of estimating variances could be recommended as an alternative to those given below.

a. Estimates and Variance of estimate of a total

Let x'_T be an estimate of a total x_T for a population segment. Then we define

$$x'_T = \sum_{k=1}^{K} \frac{M_k}{m_k} \sum_{i=1}^{m_k} \frac{N_{ki}}{n_{ki}} \sum_{j=1}^{n_{ki}} x_{kij}$$

Except for problems of non-response, the ratios $\frac{N_{ki}}{n_{ki}}$ are the same for all selected projects in a stratum, and the ratios $\frac{M_k}{m_k} \frac{N_{ki}}{n_{ki}}$ are constant for all projects in the sample from the selected strata.

Let

$$x_{ki} = \sum_{j=1}^{N_{ki}} x_{kij}$$

We define $\bar{x}_{ki} = \frac{1}{N_{ki}} x_{ki}$

and $\bar{\bar{x}}_k = \frac{1}{M_k} \sum_{i=1}^{M_k} x_{ki}$

Let $S^2_{Bk} = \frac{1}{M_k-1} \sum_{i=1}^{M_k} \left(x_{ki} - \bar{\bar{x}}_k\right)^2$

$$S^2_{ki} = \frac{1}{N_{ki}-1} \sum_{j=1}^{N_{ki}} \left(x_{kij} - \bar{x}_{ki}\right)^2$$

$$S^2_{wk} = \frac{1}{M_k} \sum_{i=1}^{M_k} \frac{N_{ki}\left(N_{ki}-n_{ki}\right)}{n_{ki}} S^2_{ki}$$

Then, the variance $\sigma^2_{x_T}$ of x_T is $\sigma^2_{x'_T} = \sum_{k=1}^{K} \frac{M_k\left(M_k-m_k\right)}{m_k} S^2_{Bk} + \sum_{k=1}^{K} \frac{M_k^2}{m_k} S^2_{wk}$

To estimate $\sigma^2_{x'_T}$ we need some further definitions.

Let

$$\bar{x}'_{ki} = \frac{1}{n_{ki}} \sum_{j=1}^{n_{ki}} x_{kij}$$

$$s^2_{ki} = \frac{1}{n_{ki}-1} \sum_{j=1}^{n_{ki}} \left(x_{kij} - \bar{x}_{ki}\right)^2$$

$$x'_{ki} = N_{ki} \bar{x}'_{ki}$$

$$\bar{x}''_k = \frac{1}{m_k} \sum_{i=1}^{m_k} x'_{ki}$$

$$s^2_{Bk} = \frac{1}{m_k-1} \sum_{i=1}^{m_k} \left(x'_{ki} - \bar{\bar{x}}'_k\right)^2$$

$$s_{wk}^2 = \frac{1}{m_k} \sum_{i=1}^{m_k} \frac{N_{ki}\left(N_{ki}-n_{ki}\right)}{n_{ki}} s_{ki}^2$$

Then $s_{Bk}^2 - s_{wk}^2$ is an unbiased estimator of S_{Bk}^2 and s_{wk}^2 is an unbiased estimator of S_{wk}^2

Hence, $s_{x_T'}^2$ is an unbiased estimator of $\sigma_{x_T'}^2$ where we define

$$s_{x_T'}^2 = \sum_{k=1}^{K} \frac{M_k\left(M_k-m_k\right)}{m_k} s_{Bk}^2 + \sum_{k=1}^{K} M_k s_{wk}^2$$

b. Variance of estimated total frequency and mean. Sometimes, the variable x_{kij} will be a variable such as age; often it will be a "counting variable"; i.e., a variable that has the value 1 if the person has a given property; e.g., "employed 3 years or more" and 0 if the person does not have that property; e.g., "not employed at least 3 years."

The total number of persons in the population segment is

$$N = \sum_{k=1}^{K} \sum_{i=1}^{M_k} N_{ki}$$

and the total number of projects is

$$M = \sum_{k=1}^{M} M_k$$

$$\bar{N}'_k = \frac{1}{m_k} \sum_{i=1}^{m_k} N_{ki}$$ To estimate N we define

$$N_T = \sum_{k=1}^{K} M_k \bar{N}'_k$$

Then the variance of the estimated total frequency, N_T, is $\sigma^2_{N_T}$ where

$$\sigma^2_{N_T} = \sum_{k=1}^{K} \frac{M_k \left(M_k - m_k\right)}{m_k} S_k^2$$

and

$$S_k^2 = \frac{1}{M_k - 1} \sum_{i=1}^{M_k} \left(N_{ki} - N_k\right)^2$$

where

$$\bar{N}_k = \frac{1}{M_k} \sum_{i=1}^{M_k} N_{ki}$$

Then an unbiased estimator of $\sigma^2_{N_T}$ is $s^2_{N_T}$ where

$$s^2_{N_T} = \sum_{k=1}^{K} \frac{M_k\left(M_k-m_k\right)}{m_k} s^2_k ,$$

and

$$s^2_k = \frac{1}{m_k-1} \sum_{i=1}^{m_k} \left(N_{ki} - \bar{N}'_k\right),$$

The mean square error of the estimated mean

$$\bar{x}' = \frac{x'_T}{N_T}$$

about the true mean $\bar{x} = \frac{x'_T}{N}$ is

approximated by

$$MSE_{\bar{x}} = \bar{x}^2 \left\{ \frac{\sigma^2_{x'_T}}{x^2_T} + \frac{\sigma^2_{N_T}}{N^2} - 2 \frac{\sigma_{x'_T N_T}}{x_T N} \right\}$$

and to estimate $MSE_{\bar{x}'}$, we need to estimate the covariance of x'_T and N_T, namely $\sigma_{x'_T N_T}$.

$$\sigma_{x'_T N_T} = \sum_{k=1}^{K} \frac{M_k\left(M_k-m_k\right)}{m_k} S_{BXNk}$$

where

$$S_{BXNk} = \frac{1}{M_k - 1} \sum_{i=1}^{M_k} \left(x_{ki} - \bar{\bar{x}}_k\right)\left(N_{ki} - \bar{N}_k\right)$$

An unbiased estimator of S_{BXNk} is

$$s_{BXNk} = \frac{1}{m_k - 1} \sum_{i=1}^{m_k} \left(x'_{ki} - \bar{\bar{x}}'_k\right)\left(N_{ki} - \bar{N}'_k\right)$$

and a consistent estimator or $MSE_{\bar{x}}$, is $mse_{\bar{x}}$, where

$$mse_{\bar{x}} = \bar{x}'^2 \left\{ \frac{s^2_{x'_T}}{x'^2_T} + \frac{s^2_{N_T}}{N^2_T} - 2 \frac{s_{x'_T N_T}}{x'_T\ N_T} \right\}$$

c. Mean square error of ratio estimates. If x_T and y_T are totals for variables x and y then the $\frac{y_T}{x_T}$ is called a ratio and $\frac{y'_T}{x'_T}$ is called a ratio estimator of $\frac{y_T}{x_T}$. (Thus a mean as defined in b, above, is a special case of a ratio estimator.)

Ratio estimators are unbiased under special conditions but unless there is a positive probability of a zero denominator,ratio estimators are consistent.

The various formulae defined in terms of the x_{kij} hold for any other variable y and hence we need only state the covariance $\sigma_{x'_T y'_T}$.

$$\sigma_{x'_T y'_T} = \sum_{k=1}^{K} \frac{M_k\left(M_k - m_k\right)}{m_k} S_{Bxyk} + \sum_{k=1}^{K} \frac{M_k^2}{m_k} S_{wxyk}$$

where

$$S_{Bxyk} = \frac{1}{M_k - 1} \sum_{i=1}^{M_k} \left(x_{ki} - \bar{\bar{x}}_k\right)\left(y_{ki} - \bar{\bar{y}}_k\right)$$

$$S_{kxyi} = \frac{1}{N_{ki} - 1} \sum_{j=1}^{N_{ki}} \left(x_{kij} - \bar{x}_{ki}\right)\left(y_{kij} - \bar{y}_{ki}\right)$$

$$S_{wxyk} = \frac{1}{M_k} \sum_{i=1}^{M_k} \frac{N_{ki}\left(N_{ki} - n_{ki}\right)}{n_{ki}} S_{kxyi}$$

An unbiased estimator of $\sigma_{x'_T y'_T}$ is $s_{x'_T y'_T}$ where

$$s_{x'_T y'_T} = \sum_{k=1}^{K} \frac{M_k\left(M_k - m_k\right)}{m_k} s_{Bxyk} + \sum_{k=1}^{K} M_k \, s_{wxyk}$$

and

$$s_{Bxyk} = \frac{1}{m_k - 1} \sum_{i=1}^{M_k} \left(x'_{ki} - \bar{\bar{x}}'_k\right)\left(y'_{ki} - \bar{\bar{y}}'_k\right)$$

$$s_{kxyi} = \frac{1}{n_{ki} - 1} \sum_{j=1}^{n_{ki}} \left(x_{kij} - \bar{x}'_{ki}\right)\left(y_{kij} - \bar{y}'_{ki}\right)$$

$$s_{wxyk} = \frac{1}{m_k} \sum_{i=1}^{M_k} \frac{N_{ki}\left(N_{ki} - n_{ki}\right)}{n_{ki}} s_{kxyi}$$

Then the approximation to the mean square error of y'_T/x'_T if given by

$$\text{MSE}_{y'_T/x'_T} = \left(\frac{y_T}{x_T}\right)^2 \frac{\sigma^2_{y'_T}}{y_T^2} + \frac{\sigma^2_{x'_T}}{\sigma_T^2} - 2\left(\frac{\sigma_{y'_T x'_T}}{y_T x_T}\right)$$

and $\text{MSE}_{y'_T x'_T}$ is estimated by $\text{mse}_{y'_T/x'_T} = \left(\frac{y'_T}{x'_T}\right)^2 \frac{s^2_{y'_T}}{{y'_T}^2} + \frac{s^2_{x'_T}}{{x'_T}^2} - 2\left(\frac{s_{x'_T y'_T}}{x'_T y'_T}\right)$

The use of the ratio estimate is indicated whenever the correlation coefficient of numerator and denominator

$$\rho_{y'_T x'_T} = \frac{\sigma_{y'_T x'_T}}{\sigma_{y'_T}\sigma_{x'_T}}$$

is positive and large, say .6 or more.

REFERENCES

All references are to Leslie Kish, Survey Sampling, John Wiley and Sons Inc, 1965.

1. Chapter 7, Selection with Probabilities Proportionate to Size Measures (PPS), p.217.
2. Section 11.2, Duplicate Listings, Overlapping Frames, p.388.
3. Chapter 6, Unequal Clusters, especially Section 6.4, p.190.
4. Section 3.6L, Optimum Stratification, p.104.
5. Section 8.6C, Special Techniques for Variance Computations. Ramdom Groups, p.287.

Appendix F

CAPABILITIES OF EXISTING DATA PROCESSING SYSTEMS[1]

To answer the question of whether or not computer programs should be generated for producing data as described in the Chapter on Data Analysis (7) a study was made of existing programs to ascertain their capabilities. Eighteen programs were examined for approximately 20 capabilities such as mass tabulations, new variables, multivariate statistics, labels and titles, and to conduct cleaning operations. Results of this study are presented in Table F 1. Column headings represent the capabilities that were examined and these are explained in the section which follows Table F1.

The code used in rating each system has the following symbols:

++	The capability is definitely present
+	It may be present
-	It is definitely absent
u	Unknown.

From the analysis of these programs, it has been concluded that many of them have the capabilities required to produce the basic analyses and cross-tabulations described in Chapter 7. It is not recommended that new programs should be generated at this time. RTB should request, however, that prosepctive contractors for the RDD&E survey should ennumerate the program capabilities that exist in their computer facilities.

Additional information on the programs examined in Table F 1 is available from:

National Program Library and
Central Program Inventory
Service for the Social Sciences

University of Wisconsin
Madison, Wisconsin

Users guides and manuals are availble in the following systems:

DATA-TEXT
IMPRESS
NORC
OSIRIS
PICKLE
PSTAT
PSH
PSL
SPSS

Other information is to be found in sources referenced at the end of this appendix.

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[1] We are indebted to Frank Many and Mrs. Baker of the Survey Research Center, University of California, Berkeley, for their study of existing computer programs.

F 2

Definition of Capabilities Used to Analyze Data Processing System

Capability	Explanation
Cross-tabulation	Tabulation of the frequency distribution of one variable's values for each category (value) of another variable. In the case of 3 variables one generates a 2-variable cross-tabulation for each value of the third variable. Idea can be extended to four, five, etc. variables. Usually such programs include one or more percentage options.
New variable generation	Often one wants to generate from a stored source variable (or set of variables) a new variable. The new variable may be the result of a straightforward algebraic operation, such as the square root of the original values or the sum of the values on a set of source variables. One may also assign values to a new variable according to whether or not a case (respondent) satisfies logical statements about certain (permutations of) values on one or more source variables. Usually tabulation programs have some primitive logical recoding capability. Larger systems should have extensive facilities for both types of new variable generation.
Statistics	Examples of univariate statistics are the well-known mean, standard deviation, median, range, mode, etc. Examples of multivariate statistics are product-moment corelations, rank-order correlations, regression coefficients, covariances, etc. Actually the term "multivariate" as used here is really a shorthand way of denoting the existence of analysis programs which generate and utilize these statistics. Many social science computer systems are rather deficient in the areas of regression analysis, analysis of variance, factor analysis, etc.
Labels, variable and category	Data (numeric values or alphanumeric category codes) are usually stored by location on cards or tape. Frequently it can be referenced by variable number, occasionally by name. Many systems and stand-alone programs permit the

Table F 1

Social Data Processing and Analysis Systems and Their Capabilities*

System	Institution	Cross Tabulations	New Variable Generation		Statistics		Labels		Titles or Text	File Sorting	Data Subsets	
			Logical	Arithmetic	Univariate	Multivariate	Variable	Category			Logical	Random
ADMINS	MIT	++	++	u	u	+	++	u	u	-	u	-
BEAST & GRASS	BROOKINGS INST	++	++	++	++	++	+	-	u	++	++	-
CODAS	U. WISCONSIN	++	u	u	u	u	++	u	++	-	u	-
DATANAL	MIT	++	+	+	++	+	+	+	+	+	+	+
DATA-TEXT	HARVARD	++	++	++	++	++	++	++	++	u	++	u
DATAX	UCLA	++	++	++	++	++	+	u	u	u	++	+
IMPRESS	DARTMOUTH	++	++	++	++	++	++	++	u	u	u	++
LANSOR	U. MINNESOTA	++	++	++	++	u	u	u	u	u	u	u
No package but probably has complete set of basic programs	NORC	++	++	++	u	u	u	u	u	u	++	u
OSIRIS	U. MICHIGAN	++	++	++	++	++	++	u	u	++	u	u
PICKLE	UC. BERKELEY	++	++	++	++	++	++	+	++	++	++	++
PSH	PACIFIC ST HOSP	++	u	++	++	++	-	-	u	++	++	-
PSL	PEABODY	++	+	+	++	++	-	-	u	++	u	u
P-STAT	PRINCETON	++	++	++	++	++	++	u	++	++	++	u
SIPS	U. WISCONSIN	-	u	u	u	u	u	u	u	u	u	u
SPSS	STANFORD	++	++	++	++	++	++	++	++	u	++	++
SSP	IBM	++	u	u	++	++	-	-	u	++	++	++
TSAR	DUKE	++	++	++	++	++	u	u	u	u	++	u

* ++ Capability definitely present; + May be present, or to a limited degree; - Definitely absent; u Unknown

Table F 1 Continued

Social Data Processing and Analysis Systems and Their Capabilities

System	File to File Information Transfer		Cleaning		Machine Readable Codebooks		Interesting Features	Machine & Language	Adopted By Others
	Same Unit of Analysis	Different Units of Analysis	Illegal Values	Logical	Integral	Apart			
ADMINS	-	-	++	++	Includes Marginals ++	u		IBM/7094 MAD,FAP	Unknown
BEAST & GRASS	+	++	+	+	++	u	Do Loops	IBM/7040 FORTRAN/COBOL	No
CODAS	-	-	-	-	-	++		CDC/3600 COMPASS, FORTRAN	No
DATANAL	u	u	+	+	+	+	Matrix Operators	IBM/7090 FAP	No
DATA-TEXT	+	+	++	++	++	u	Matrix Operators	IBM/7090 FAP,FORTRAN	No
DATAX	+	u	-	-	u	u		IBM/1800 FORTRAN	No
IMPRESS	++	++	u	u	++	u		GE/635 BASIC	No
LANSOR	+	+	u	u	u	u	User written routines,user language same as data-text	CDC/6600, 3200 FORTRAN	No
NORC	u	u	++	++	u	u	Exit to User Links	IBM/360	Unknown

OSIRIS	+	u	++	++	++	u		IBM/360 FORTRAN	Yes
PICKLES	++	++	++	++	u	u		CDC/6400 COMPASS, FORTRAN	No
PSH	-	-	++	-	-	-		CDC/6400 FORTRAN	Unknown
PSL	u	u	++	-	-	-		IBM/1130	Unknown
P-STAT	++	+	++	++	u	u	Do loops, user written links, can transform OSIRIS files, matrix operators	IBM/7094 GE/635 FORTRAN	Yes
SIPS	u	u	++	u	++	u	Used in connection with CODAS	CDC/3600 FORTRAN, COMPASS	Unknown
SPSS	++	+	++	u	++	u		IBM/360 FORTRAN	Yes
SSP	-	-	u	u	-	-	Subroutines, no main program	IBM/360 IBM/1130 FORTRAN	Unknown
TSAR	u	u	u	u	u	u		IBM/360 IBM/7070 ASSEMBLER	Yes

Capability	Explanation
	user to input with his analysis requests variable names which will label the output. Less common is the ability to input 4-,6-, or 10-character names for a variable's categories. Many of the larger systems store variable names permanently and automatically label all output with them. Rare is the system which permanently stores and uses category labels automatically. Possession of such a feature probably implies that the system links the data set to a machine-readable codebook.
Titles or text	For bookkeeping and/or explanatory reasons, it is useful to be able to entitle all or some of the pages of coumputer output with long (80 or more characters) labels. Stand-alone programs tend to be rather primitive in this regard. They may permit merely a single, one-line title per job or merely a single-line title about each tabulation. Some of the larger systems have essentially unlimited capacity in the area of titles and explanatory text. It is only a small step from extensive text capacity to the nearly automatic production of machine-readable codebooks.
Data subsets	For reasons of economy or analytic interest the user may wish to limit his analysis requests to a particular subset of the stored data. Even small tabulation programs usually have some ability to temporarily filter out data which do not meet some logical condition. In large systems it is desirable to be able to permanently store "Boolean" variables defining logical subsets of the data. Many of the larger systems contain random number generating routines which can be used to draw random subsamples of the cases. For reasons of economy some systems can create permanent subfiles representing logical or random subsets of the original data.
File to file information transfer	Creation of permanent subfiles is one type of file to file information transfer. Another simple type is case-wise concatenation of files containing the same information (variables) for different samples of respondents. A third simple type is variable-wise concatenation of files of different variables for the same

Capability	Explanation
	sample of respondents. A variation on the last is the transference of only selected variables from one file to another. In all of the above examples the unit of analysis, whether it be individual, household, company or nation, remains the same. A radically different type is the aggregation or distribution of information from a file with one unit of analysis to a file based upon a different unit of analysis. For example, suppose one wanted to build a file containing information on the racial, economic and education characteristics of each of the blocks in a city. If one had at hand data on individuals (including place of residence), then one could compute block-by-block median income, proportion black, frequency distribution of grades completed; and transfer the information to a city block file. Only two of three of the systems on the chart have been designed to facilitate this operation.
Cleaning	The data set, as initially prepared from the source documents, is usually faulty in three basic ways. First, whole records or data fields are missing or duplicated. Secondly, illegal values will be recorded for a variable. Thirdly, the values associated with a set of variables will violate the built-in logic of the relations among the variables. For example, respondents under the legal voting age should not be recorded as having voted for any of the candidates for office. Thus, the complete data processing system should be able to detect these three types of errors, put out sufficient information (identification number, location of data field, condition violated, etc.) to facilitate preparation of the corrections, and finally accept the corrections and update the data set so that it is correct. Few systems really have this complete data cleaning capability; however, many do have logical and list printing facilities which can be applied to the task. In fact, even stand-alone tabulation programs can be used to determine which of the variables have been punched with out-of-range values. Cleaning is such a special part of data processing, however, that in the present state of the art it is still done best by stand-alone programs designed for that function and that function only. A good example is NORC's "CLEAN-3".

F 8

Capability	Explanation
Machine-readable codebook	Simple typewritten codebooks suffice for data sets worked upon by a single research group, for a limited period of time, using only stand-alone programs or a simple data processing system. If, however, the study will be widely distributed for an indefinite time, it becomes advantageous to senders and receivers alike if both the data set and the codebook are stored on magnetic tape. Such codebooks are even more useful when an integral part of their content is the raw frequency distribution on each variable. It is also the case that sophisticated and powerful data processing systems cannot function unless they are first given a dictionary which adequately describes/defines the data file. For some systems labels, titles, etc. are optional, but for others they are obligatory. In effect, then, large systems tend to require something akin to a codebook. The other side of the story is that some of these systems can generate updated codebooks describing the original and new variables and giving frequency distributions, means, standard deviations, etc.

References

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APPENDIX G
SURVEY COST SUPPORT INFORMATION

Estimated Costs for 240 15-Minute Scheduling Calls and 60-Minute Interviews by Telephone (Using 4 Regional Areas and Their Average Distance from San Francisco)

COL. 1 REGION	COL. 2 Average Distance in miles	COL. 3 Number of calls	COL. 4 1st 3 min. cost	COL. 5 Col. 3 X Col. 4	COL. 6 Cost of remaining minutes in call	COL. 7 Col. 3 X Col. 6	COL. 8 Cost Col. 5 + Col. 7	COL. 9 10% tax of Col. 8	COL. 10 Col. 8 + Col. 9	COL. 11 Combined costs of scheduling and interviewing calls
East Scheduling calls (15 min.)	[a] 2446	[b] 90	$1.35	$121.50	12 min.@ $.45= $5.40	$486.00	$607.50	$60.75	$668.25	
Interviewing calls (1 hour)	2446	[c] 70	1.35	94.50	57 min. @ $.45= $25.65	1795.50	1890.00	189.00	2079.00	$2747.25
Mid-west Scheduling calls (15 min.)	1766	90	1.25	112.50	12 min.@ $.40= $4.80	432.00	544.50	54.45	598.95	
Interviewing calls (1 hour)	1766	70	1.25	87.50	57 min.@ $.40= $22.80	1596.00	1683.50	168.35	1851.85	2450.80
West-Rocky Mt. Area Scheduling calls (15 min.)	1168	90	1.15	103.50	12 min.@ $.35= $4.20	378.00	481.50	48.15	529.65	
Interviewing calls (1 hour)	1168	70	1.15	80.50	57 min.@ $.35= $19.95	1396.50	1477.00	147.70	1624.70	2154.35
Far West Scheduling calls (15 min.)	417	90	.80	72.00	12 min.@ $.22= $2.64	237.60	309.60	30.96	340.56	
Interviewing calls (1 hour)	417	70	.80	56.00	57 min.@ $.22= $12.54	877.80	933.80	93.38	1027.18	1367.74
TOTALS				$728.00		$7199.40	$7927.40	$792.69	$8720.14	$8720.14

Footnotes for this table and the subsequent table may be found on page G-3.

APPENDIX G

Estimated Costs for 240 10-Minute Scheduling Calls and 30-Minute Interviews by Telephone (Using 4 Regional Areas and Their Average Distance from San Francisco)

COL. 1 REGION	COL. 2 Average Distance in miles	COL. 3 Number of calls	COL. 4 1st 3 min. cost	COL. 5 Col. 3 X Col. 4	COL. 6 Cost of remaining min. in call	COL. 7 Col. 3 X Col. 6	COL. 8 Cost Col. 5 + Col. 7	COL. 9 Add 10% tax to Col. 8	COL. 10 Col. 8 + Col. 9 (cost+tax)	COL. 11 Combined cost of scheduling & interviewing calls Col. 10 (a+b)
East Scheduling calls (10 min.)	2471[a]	90[b]	$1.35	$121.50	7 min. @ 45¢ = $3.15	$283.50	$405.00	$40.50	$445.50 (a)	
Interviewing calls (30 min.)	2471	70[c]	$1.35	$94.50	27 min. @ 45¢ = $12.15	$850.50	$945.00	$94.50	$1,039.50 (b)	$1,485.00
Mid-West Scheduling calls (10 min.)	1766	90	$1.25	$112.50	7 min. @ 40¢ = $2.80	$252.00	$364.50	$36.45	$400.95 (a)	
Interviewing calls (30 min.)	1766	70	$1.25	$87.50	27 min. @ 40¢ = $10.80	$756.00	$843.50	$84.35	$927.85 (b)	$1,328.80
West-Rocky Mtn. Scheduling calls (10 min.)	1168	90	$1.15	$103.50	7 min. @ 35¢ = $2.45	$220.50	$324.00	$32.40	$356.40 (a)	
Interviewing calls (30 min.)	1168	70	$1.15	$80.50	27 min. @ 35¢ = $9.45	$661.50	$742.00	$74.20	$816.20 (b)	$1,172.60
Far West Scheduling calls (10 min.)	418	90	$ .80	$72.00	7 min. @ 22¢ = $1.54	$138.60	$210.60	$21.06	$231.66 (a)	
Interviewing calls (30 min.)	418	70	$ .80	$56.00	27 min. @ 22¢ = $5.94	$415.80	$471.80	$47.18	$518.98	$756.64
TOTALS				$728.00		$3578.40	$4306.40	$430.64	$4737.04	$4,737.04

Cities Used to Arrive at Distrance Estimates for Four Regional Areas in the U.S. (Distances from San Francisco)

East

City	Distance
Boston	2717 miles
Washington	2412 "
New York	2544 "
Atlanta	2111 "

Average distance from S.F. - 2446 miles

West-Rocky Mtn. Area

City	Distance
Denver	948 miles
Omaha	1413 "
Albuquerque	897 "
Lincoln, Nebr.	1413 "

Average distance from S.F. - 1168 miles

Mid-West

City	Distance
Cleveland	2131 miles
Chicago	1858 "
New Orleans	1922 "
Dallas	1461 "
Kansas City	1458 "

Average distance from S.F. - 1766 miles

Far West

City	Distance
Seattle	694 miles
Portland	544 "
Los Angeles	345 "
San Diego	454 "
San Francisco	(assume 50-mile area)

Average distance from S.F. - 417 miles

Current Telephone Rates (per minute costs) For Varying Distances from San Francisco

Distance	First 3 Minutes*	Each Minute Thereafter*
0-10 miles	$ .17	$ .05
100-124 miles	.65	.18
125-430 "	.80	.22
431-674 "	1.00	.30
675-925 "	1.05	.35
926-1360 "	1.15	.35
1361-1910 "	1.25	.40
1911-3000 "	1.35	.45

*Subject to 10% tax

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[a] See table of cities selected to determine average distance.

[b] 90 scheduling calls are estimated for each region before 60 are confirmed because of turn-downs, non-existent RDD&E employees, call backs, etc.

[c] 70 calls estimated to obtain 60 interviews due to re-scheduling, interrupted interviews, call backs, etc.